LITERATURE ON SURFACTANTS AND DETERGENTS : (1999-2000) A BIBLIOMETRIC STUDY

DISSERTATION

SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE OF THE

Master of Library & Information Science

(2001-2002)

By

MOHSINA MOHSIN

Roll No. 412
Enrol No. X-2721

Under the Supervision of

PROF. SHABAHAT HUSAIN
(Ex-Chairman)

DEPARTMENT OF LIBRARY & INFORMATION SCIENCE
ALIGARH MUSLIM UNIVERSITY
ALIGARH (INDIA)

2002

ALIGARH MUSLIM UNIVERSITY, ALIGARH

EPARTMENT OF LIBRARY AND INFORMATION SCIENCE

Phone (EPBX : 700916, 20-23, 26 Ext. 193/4
Direct : 700039
Fax : 91-0571-400528, 401221

Ref. No.....
Dated...28.08.02.....

Prof. Shabahat Husain
B.Sc. (Hons.), M.Sc., M.Lib.Sc. (Alig.), M.Phil. (U.K.)
Ex-Chairman

CERTIFICATE

This is t o certify that **Ms. Mohsina Mohsin** has completed her dissertation entitled **"Literature on Surfactants and Detergents : A Bibliometric Study (1999–2000)"**, in partial fulfillment of the requirements for the degree of **Master of Library and Information Science (2001–2002)**. She has conducted the work under my supervision and guidance. I deem it fit for submission.

S. Husain
Prof. Shabahat Husain

Postal Address : 4/465, SHARAFAT LODGE (BEHIND AKBAR MARKET), CIVIL LINES
ALIGARH-202 002 (U.P), INDIA

DEDICATED TO

MY

LOVING PARENTS

AND MY

HUSBAND

CONTENTS

LIST OF TABLES

LIST OF GRAPHS

ACKNOLEDGEMENT

My all praise for Almighty Allah whose kind grace helped me to complete this dissertation.

I would like to express my deep sense of gratitude to my respected teacher and Supervisor Prof. Shabahat Husain, Department of Library and Information Science, A.M.U., Aligarh, for his invaluable guidance and advice. Without his constant support and encouragement this task would have been difficult to accomplish.

I am grateful to Mr. S. Mustafa K. Q. Zaidi, Chairman, Department of Library and Information Science, for his inspiration and guidance.

My sincere and special thanks go to all my teachers namely, Mr. Naushad Ali P. M., Ms. Sudharma Haridasan, Mr. M. Masoom Raza, Ms. Nishat Fatima and Mr. Asif Fareed Siddiqui, Department of Library and Information Science, for their inspiring support.

Sincere thanks are also due to Mr. Khwaja Moin Ahmad, Mr. Riaz Abbas and Mr. Asrar Ahmad Khan, staff of the seminar library and other office staff for their wholehearted cooperation during the completion of this dissertation.

I am highly thankful to Prof. Mohd. Ilyas and Prof. Kabiruddin, Department of Chemistry, for their kind help and cooperation. Thanks are also due to Mr. Javed, Mr. Wiqar and Ms. Tasneem and other, staff of seminar library of the Department of Chemistry.

My heartfelt thanks are due to all my friends and classmates, Ms. Halima Naim, Ms. Uzma Naseem, Ms. Uzma Chishti, Ms. Talat, Ms. Shagufta, Ms. Munawwar, Ms. Semin, Ms. Rana, Messrs Hamza, Irshad, Vishnu, Mustafa, Salman and Moin for their cooperation and moral support.

I am extremely grateful to my loving mother, brothers, Messrs Naimuddin, Pervez, Javed, Shahnawaz and Shadab and sisters Gohar Anjum and Rizwana, for their assistance and moral support.

I am also indebted to my loving in laws and all kith and kin that are the embodiment of sacrifice and a source of inspiration and affection for me all the time.

Last but not least, I would like to thank my husband Mr. Salim Akhtar for encouraging, helping and supporting me during the course of completion of the present work.

MOHSINA MOHSIN

CHAPTER - I

BIBLIOMETRICS

INTRODUCTION

Discipline that investigates the properties and behaviour of information, the forces governing the flow of information, and the means for processing information for optimal accessibility and usability is termed as "Information Science". It occurs individually as well as in combination with other words such as information analysis, information service, information source, scientific and technological information and so on.

Information may be defined as: -

"Information is the message conveyed or intended to be conveyed by a systematised body of ideas or its accepted or acceptable substitutes".

- According to D. Bell[1](1979) "Information is news, facts, statistics, reports, legeslation, text lodes, judicial decisions, resolutions and the like".
- According to Machlup[2](1983) " Information is the piecemeal, fragmented, timely, transitory.... flow of messages".

The term information science was coined first in U.S.A. in 1959. The most significant use of the term is to be seen in the changing of the name of the American Documentation Institute (ADI) to American Society for Information Science (ASIS) in 1968. The title of its journal "American Documentation" was changed to "Journal of the American Society for Information Science (JASIS) in 1970.

Information Science is a discipline concerned with the study of property and behaviour of information as well as the factors influencing the flow of information.

In the present age, librarians have been observing the evergrowing number of bibliographic units like books, periodicals, articles in periodicals; corresponding increase in the size of library collection, number of readers, issue of library material, number of catalogue cards, changes in search strategy and so

---

[1] BELL(D). Social framework of information theory. *In* DERTOUZOS(ML) and MOSES(J), *Eds.* Computed age: A twenty year view. 1979. MIT Press, Cambridge. P 163-211.

2 MACHLUP(F) and MANSFIELD (U). Study of information, interdisciplinary messages. 1983. Wiley, NewYork. P743.

on. This becomes all the more problematic because of the in elastic budgetary provisions. Realizing these factors, no single library can afford to acquire every document. Hence, limited and selected procurement of journals seems to be one of the practical remedies. Bibliometric is relatively a new one recent origin, which has emerged to identify the pattern of publications, authorship, and citations used for a subject etc. over a period of time and thereby offering insight into the dynamics of the area under a particular study.

1. BIBLIOMETRICS

Bibliometric has been derived from the two words 'Biblion' and 'Metric'. The word 'Biblion' means Books and 'Metric' means measurement. So, Bibliometrics generally means 'Measurement pertaining to Books'.

It implies a use of quantitative or statistical method to study the behaviour of information.

This term is comparatively of Recent Origin and Bibliometric studies are being conducted in different disciplines.

1.1 Origin and History

First study regarding Bibliometrics was conducted in 1917 by 'Cole' and 'Eale'. They wrote on "The History of Comparative anatomy Part-I: A Statistical Analysis".

First term used for this was "Statistical Analysis".

Henkle (1938), Gosnell(1943\44), Barker (1966) also used the same term i.e. 'Statistical Bibliography'.

In 1968 Pritchard analyzed the term ' Statistical Bibliography' and found to be confusing with 'Statistics' and 'Bibliography on Statistics'. Therefore he coined another term i.e. called 'Bibliometrics'.

Hence, the term Bibliometric has a very recent origin. The term Libra metrics, 'Scientometrics', Econometric and Informatrics are also used in literature.

Bibliometrics is analogus to Ranganathan's librametrics, Russian concept 'Scientometrics', FIDS 'Informatics' and also to some other well established sub-disciplines like 'Econometrics', 'Psychometrics', 'Sociometrics' and 'Biometrics'.

1.2 Definitions

Bibliometrics is that branch of science which studies the behaviour of information.

We can also say that "Bibliometric" is that branch of information theory that attempts to analyse quantitatively the properties and behaviour of recorded knowledge.

Different people have defined it in different ways: -

I) Hulme (1923)[3]: The purpose of Statistical Bibliography is to shed light on the process of written communication and of the nature and course development of a discipline by means of counting and analysing the various facets of written communication.

II) Raising (1962)[4]: The assembling and interpretation of statistics relating to books and periodicals ..... use of books and journals and to ascertain in many local situations the general use of books and journals.

III) Pritchard (1969)[5]: Application of mathematical methods to books and other media of communication.

IV) Fairthorne (1969)[6]: Quantitative treatment of the properties of recorded discourse and behaviour appertaining to it.

---

[3] HULMES(EW). Statistical bibliography in relation to growth of modern civilization 1923 Grafton, London.

[4] RAISING (LM). Statistical bibliography in the health science. *Bull of medical library association* 50, 1962; 450-461.

[5] PRITCHARD(Alan). Statistical bibliography of bibliometrics. *Journal of documentation* 25; 1988, 179-191

[6] FIARTHORNE (RA) Empirical hyperbolic distributions (Bradford, Zipf-Mandelbort) for bibliometric description and prediction *Journal of Documentation* 25 , 1969 , 319

V) Hawkins (1977)[7]: Quantitative analysis of the bibliographical features of a body of literature.

VI) Potter[8]: Bibliometric is the study and measurement of the publication patterns of all forms of written communication and their authorship.

VII) Schrader[9]: "Bibliometric is the scientific study of recorded discourse".

VIII) Broadus[10]: Bibliometric is the quantitative study of physical published units or of Bibliographic Units of Surrogates either.

IX) Sengupta[11]: Organization, Classification and Quantitative evolution of publication patterns of all macro and micro communications along with their authorship by mathematical and statistical calculus.

X) British Standard Institute[12]: The study of the use of documents and patterns of publication in which mathematical and statistical method have been applied.

2. BIBLIOMETRICS; Its Scope:

The scope of bibliometric includes the studying of relationship within a literature or describing a literature. Typically these descriptions focus on consistent patterns involving Authors, Monographs, Journals, Subject, Languages Forms.

Bibliometric studies fall mainly into two broad groups:

a) Descriptive Studies: Those describing the characteristics or features of literature.

b) Behavioural Studies: Those examining the relationship formed between components of a literature.

The techniques of bibliometric are simple to complex in nature. The basic units of bibliometric are all facets of written communication, such as Primary and

---

[7] HAWKINS (DT) Unconventional uses of online information retrieval system Online bibliometric studies *Journal of American Society for Information Science* 28, 1, 1977, 13-18

[8] POTTER (WG) Introduction to bibliometrics *Library Trends* 30 , 1981, 5

[9] SCHRADER (Alvin M) Teaching bibliometrics *Library Trends* 30, 6, 1981, 15

[10] BROADUS (RN) The application of citation analysis to collection building *Advance in Librarianship* 7, 1977, Academic Press New York

[11] SENGUPTA (IN) Bibliometrics and its application *In* PUSHPA DHYANI , *Ed* Information Science and Libraries 1990 Atlantic New Delhi P 256

Secondary periodicals, Articles, Books, Monographs and other media of communication. Bibliometric techniques have extensively applied equally in Sociological Studies of Science Information Management, Librarianship, history of science including science policy, Study of Science and Scientists and also in different branches of Social Science. Bibliometric laws are useful in understanding some of the information phenomena and may help in planning many of the library activities, as they indicate certain basic patterns and relationships governing information items and activities. The study mostly relates to quantification of items and their pattern of distribution. Hyperbolic distribution and exponential growth are the prominent trends underlying information and document phenomena. The studies throw light on the pattern of growth of literature, productivity and influence of authors, interrelationship among different branches of knowledge, distribution of terms in information storage and retrieval pattern of collection build up, their use and the like.

2.1 Purpose of Bibliometrics:

Pritchard assigned its purpose as to shed light on the process of written communication and of the nature and course of development of a descriptive means of counting and analyzing the various facts of written communication.

According to Dr. S. N. Singh "The purpose of bibliometric is to provide quantitative analysis of the phenomenon going with documents, their organization, use and services in library and Information Centres and Systems. It offers to the information worker a type of statistical technique for the study of characteristics and attributes of literature and that of communication media.

The main purpose of bibliometric study is:

- To find out major form of literature.
- To prepare a ranked list of journals.
- To make a comparison between ranked journals.
- To identify the country with greatest library output.
- To find out the chronological scattering of all cited literature.
- To ascertain the amount of utilization of language.

Some other purposes are:

- To develop norms and standardization.
- To regulate inflow of information and communication.
- To identify authorship and its trends in documents of different subjects.
- To measure useful news of adhoc and retrospective SDI services and so on.

3. UTILITY OF BIBLIOMETRIC IN RESEARCH:

At present, bibliometric work often provides the background for a more practical task. It is an established technique covering wide area of knowledge. It has therefore been able to involve scholars from many of these disciplines. Consequently it has attracted scholars from different disciplines or their respective fields. Day by day, it is attaining sophistication and complexity having national, international and interdisciplinary character. It has established itself as a viable and distinctive research technique for studying science of science based on bibliographic data. As a matter of fact, its backbone lies in its sound theoretical foundation most efficiently and effectively laid by some pioneers like Gross, Lotka, Bradford, Zipf, Derek J. De Solla Price, Bookstein, Massavesik, Cole brother, Pritchard, Garfield, Hulme, Fairthorne and many others who are all not basically librarians, but belong to different branches of knowledge.

The techniques evolved by these pioneers are capable of throwing light to various complicated problems faced by many while handling information to quantify the process of written communication. It has established itself as a viable and distinctive research tool for quantitative measurement of human knowledge. Data analysis both of citations and of volume of publications year by year can be useful in planning retrospective bibliographies.

Bibliometric also provides information about the structure of knowledge. Its classification studies give information about the subject, language and country relationship which is based on literary warrant. Bibliometric is very useful in any field of research or in any discipline or it can be used in small and manageable ways by individuals, to improve some part of library or information service.

4. BIBLIOMETRIC LAWS:

There are three fundamental laws, which laid the formation of bibliometrics:

4.1 Lotka's inverse square law of scientific productivity.

4.2 Bradford's law of scattering.

4.3 Zipf's law of word occurrence.

4.1 Lotka's Inverse Square Law:

The frequency distribution of productivity of authors of scientific papers was first studied by Alfred Lotka, who proposed that the number of authors making n contributions is about $1/n^2$ of those making one contribution, and the proportion of all contributors who make a single contribution is about 60 per cent, or $a(n)=k/n^2$.

Where 'a' is the number of authors producing n papers and k a constant. In other words, for every 100 authors contributing one article, 25 will contribute two articles, about 11 will contribute 3 articles and 6 will contribute 4 articles and so on.

4.2 Bradford's Law of Scattering:

S.C. Bradford gave this law in 1948. S.C. Bradford examined two bibliographies prepared in science library on Applied Geophysics and Lubrication and he prepared lists of journals arranged by decreasing order of source items contributed by the journals to the Bibliographies.

He noticed that in each subject, there were a few very productive sources, large number of sources of constantly diminishing productivity. In the list of periodicals ranked by diminishing productivity, Bradford identified three groups of periodicals that produced approximately the same number of articles on the subject, but the

number of periodicals in these three equi-productive zones increased by a constant factor.

Based on this he stated this law as, " If scientific periodicals are arranged in order of decreasing productivity of articles on a given subject that may be divided into a nucleus of periodicals more particularly devoted to the subject and several groups or zones containing the same number of articles as the nucleus when the number of periodicals in the nucleus and succeeding zones will be given as:

$$1:n:n^2$$

4.3 Zipf's Law of Word Occurrence:

Zipf gave this law in 1949. Zipf developed and extended an empirical law, as observed by Estoup governing a relation between the rank of a word and the frequency of its appearance in a long text.

If 'r' is the rank of a word and 'f' is its frequency, then mathematically Zipf's law can be stated as follows:

rf=c, where 'c' is a constant.

This law states that in a long textual matter if words are arranged in their decreasing order of frequency, then the rank of any given word of the text will be inversely proportional to the frequency of the occurrence of the word.

He found that by multiplying the numerical value of each rank (r) by its corresponding frequency (f), he obtained a product (c) which is constant throughout its text e.g.:

Rank (r)	Frequency (f)	Product (rf)=c
1	400	400
2	200	400
3	133	399
4	100	400
5	80	400

6	66	396
7	58	406
8	50	400
9	41	369
10	40	400

Table shows distribution of words inversely proportional to the frequency of occurrence of the word.

Thus, These three laws are respectively based on

(i) Number of authors contributing in a discipline or other field;

(ii) Distribution of articles in a set of journals;

(iii) Ranking word frequency in a paricular set of documents.

Other Laws:

The three other important laws that need to be mentioned here are:

4.4 Price's Square Root Law of Scientific Productivity:

Derek De Solla Price gave this law in 1963. This law states, that "Half of the scientific papers are contributed by the square root of the total number of scientific authors".

4.5 Garfield's Law of Concentration:

Eugene Garfield enunciated this law in 1971. This law states, that " A basic concentration of journals is the common core of nucleus of all fields"

4.6 Sengupta's Law of Bibliometrics:

Sengupta has put this law forward in 1973, which is also known as off setting weightage formula for re-ranking periodicals to avoid discrimination against new journals, which necessarily have fewer citation credits. This is basically an extension of the Bradford Law

It states that "during phase of rapid growth of knowledge in a scientific discipline, articles of interest to that discipline appear in increasing number of periodicals distant from that field".

Mathematically this law stands in the following form:

$f(x+y)=a+b \log(x+y)$

Where f (x+y) is the cumulative number of references in the first (x+y) most productive journals, x indicate number of journals in the same discipline and y stands for number of journals of unrelated discipline (y>x) and a and b are two constants.

5 Subdivisions of Bibliometrics:

5.1: Operation Research (Linear Programming, Transport problems)

5.2 Statistics (Multivariable techniques, trends, correlation).

5.3 Bibliometric Laws (Laws of Zipf, Lotka and Bradford).

5.4 Citation Analysis (Networks, Science Policy).

5.5 Circulation Theory (Models).

5.6 Information Theory.

5.7 Theoretical aspects of Information and retrieval.

6. Application of Bibliometrics:

As bibliometrics lies between the border areas of social science and physical sciences, its techniques have extensive applications equally in sociological studies of science, information management, librarianship, and history of science and also in some other branches of social science and sciences. Some of the areas where bibliometrics techniques are consistently being applied are enumerated here:

- To design information services.
- In library management.
- Evaluation of indexing services and retrieval system.
- Weeding and stacking policy.
- To find out core journals by applying Bradford Law.

- To find out trends in research activities.
- Trends in authorship.
- To find out the distribution of scientific articles or scattering of articles through applying Bradford Laws.
- To find out the productivity of scientists by applying Lotka's Law.
- To lead the reader to further studies in the field.
- Help in Preparation of Bibliographies.
- To find out the relative use of different languages.
- To study the use of literature from different countries.
- To study the scattering of subject.
- To study the rate of collaborative research.

7. Limitations In Application:

Though most of the studies tend to support the Bradford distribution some other researcher could not get the satisfactory results. Gross found that the scatter of research papers among physics journals deviated from that predicted by Bradford's Law. Out of 50 Bibliographies studied by Chonez,only six followed the law. Therefore, he calls the low pseudo scientific.

7.1 Lotka's Law:

In the case of Lotka's Law it was found to fit in most cases. However the value of indexing was found to vary for different groups of scientists.

Another problem with Lotka's law is that it totally ignores the potential authors who have not produced any publication so far.

7.2. Citation Analysis:

In case of Citation Analysis, the common arguments against it are:

- Too much of self-citation and in house citation.
- Practice or citing only to get the favour of the powerful or to appears others.
- Citation given just to dress up the paper.
- Variation of citation rate during lifetime of paper.

- Variation of citation rate with type of paper and speciality.
- Negative citation

Because of all these limitation the empirical nature of these laws are generally questioned.

CONCLUSION:

Bibliometrics has emerged as the most active field of library and information science during the past few decades. It is estimated that the literature on this topic occupies more than 25% of the total contribution in library and information science. Citation Analysis studies form a major portion of it, pertains to the application of bibliometric laws. However, there is a long way to go in achieving perfection in the studies. Even the spread of computers for retrieval, counting and analysis are unlikely to achieve perfection in the studies. This study is merely a method, not a theory. To make it a theory and more useful, researchers must concentrate on the casual factors underlying Bibliometric phenomena. The changes that are frequently occupying in the publication practices are likely to complicate the studies in future. In such circumstances it is advisable to consider the results of such studies as more guidelines rather than ends in themselves.

Bibliometric is a formal scientific subdiscipline that includes the complex of mathematical and statistical method, used to analyze bibliographical characteristics of documents. It has been recognized as the structure part of the methodology of library and information science also.

CHAPTER - II

Introduction

1. Characteristics of Surfactants
2. Classification of Surfactants
3. Solubility and surface activity of Surfactants
4. Wetting and detergent structures in Surfactants
5. Effect of surfactant on the properties of solutions
6. Wetting characteristics of Surfactants
7. Micellar Solubilization of Surfactants
8. Uses of Surfactants
9. Biodegradibility of Surfactants and water pollution
10. Strategies for avoiding Surfactants
11. Detergents
12. Principal Groups of Synthetic Detergents
13. Classification of Detergents
14. Subsidiary Constituents of Detergents
15. Advantages of detergents over soaps
16. Conclusion

Surfactants and Detergents: An Introduction

Water, the liquid commonly used for cleaning, has a property called surface tension. In the body of the water, each molecule is surrounded and attracted by other water molecules. However, at the surface, those molecules are surrounded by other water molecules only on the waterside. A tension is created as the water molecules at the surface are pulled into the body of the water. This tension causes water to bead upon surfaces [glass, fabric], which shows wetting of the surface and inhibits the cleaning process. You can see surface tension at work by placing a drop of water onto a counter top. The drop will hold its shape and will not spread.

In the cleaning process, surface tension must be reduced so water can spread and wet surfaces. Chemicals that are able to do this effectively are called **Surface-active agents, or Surfactants**. They are said to make water "wetter".

A surfactant is an organic compound that encompasses in the same molecule two dissimilar structural groups, e.g., a water-soluble and a water insoluble moiety. The composition, solubility properties, location and relative sizes of these dissimilar groups in relation to the overall molecular configuration determine the surface activity of a compound. The water soluble moiety is generally referred to hydrophilic [water loving], lipophobic and oleo phobic and the water insoluble moiety is called hydrophobic [water-hating], lipophilic and oleophilic. The water hating ends attach themselves to the soil particles present in or on the fabrics being washed, while the water-loving ends are attracted to the water. The surfactant molecules surround the soil particles, break them up and force them away from the surface of the fabric, then suspend the soil particles in the wash water.

1. Characteristics of Surfactants

- It must be soluble in at least one phase of a liquid system.

- Its molecules are composed of groups with opposing solubility tendencies.
- At the interphase of a liquid system it must form oriented monolayers and its equilibrium concentration at a phase interface is greater than its concentration in the bulk of the solution.
- It forms micelles if the concentration of the solute exceeds a limiting value in the bulk of the solution.
- Solution of surfactants exhibits detergency, foaming, wetting, emulsifying, solubilizing and dispersing properties either individually or collectively.

The term 'surfactants' may be applied to any chemical that exhibits the property of orienting itself between two interfaces in such a way that it becomes a coupling agent, bringing the interfaces into more intimate contact. The interface may be between liquid and gas such as water and air, in which case a foaming agent results. Or, the interfaces may be between solid and liquid, such as cotton and water, in which case a wetting agent results. Or, the interfaces may be between two immiscible liquids, such as water and oil, where the surface –active agent lowers the interfacial tension so that an emulsion is formed, in which case an emulsifying agent results. If the surface-active agent combines wetting and emulsifying properties to a suffecient degree, together with other necessary properties, the surface-active agent is called detergent.

Surface active agents, in general, have some or all of the following properties: wetting out, dispersing, emulsifying, penetrating and cleaning. Soap is the oldest, the best known, and still the most commonly used surface-active agent. Soap has been the main cleaning agent for centuries. However, within the past fifty years or so, considerable effort and research have been directed to the development of surface active agents to perform specific task and with a view to overcome the limitations of soaps, particularly in hard water and in the presence of high salt concentrations. Among the first of the substitute materials developed was sulphated caster oil or turkey red oil, next, it was discovered that the sodium sulfonate or naphthalene, to which a short chain of carbon atoms had been attached, had surface tension depressant properties.

The earliest of the synthetic detergents to invade the commercial field were the sodium salts of the higher alcohol sulfates, which has many of the properties of soap. They compared well, as far as detergency, wetting, and foaming power were concerned, and in addition, their calcium and magnesium salts were water soluble, and did not precipitate from hard water solutions. Then the alkyl aryl sulfaonates were introduced, they were stable in hard water and acid solutions, had excellent detergent and wetting properties, and were manufactured from low-priced petroleum, rather than the costlier vegetable oil necessary to produce the higher alcohol sulfates.

2. Classification of surfactants

The surfactants may now be classified according to the raw materials used in their manufacture; that is, petroleum and coal tar products, such as the alkyl and alkyl-aryl sulfonates; detergent based on synthetic organic chemicals,as the sulfonated succinic acid ester, polyglycol ethers; and those based on fats such as the sulfated fatty acids, amides and esters.

For the purpose of application, the surface-active agents are divided into groups based on their chemical structure and behavior in solution. Accordingly the following classification apply:

2.1 Anionic Surfactants:

These are characterized by the fact that in water solutions, the molecules ionize in such a way that the hydrophilic group carries a negative charge. These are further subdivided into the following categories.

2.1.1 Alkyl aryl sulphonate (e.g. Dodecyl benzene sulphonate)

2.1.2 Alkyl sulphate and sulphonates

2.1.3 Sulphated and sulphonates Esters

2.1.4 Sulphated and Sulphonated amides and amines.

2.2 Cationic Surfactants:

In this group falls a series of compounds, related to ammonium halides and called cationic because the organic part of the molecule takes on a positive charge. e.g.: Lauryl dimethyl benzyl ammonium chloride

2.3 Non Ionic Surfactants:

This class is characterized by the fact that it does not ionize in aqueous solutions.

E.g.: Poly ethenoxy glycol Ester of stearic acid

Polyethenoxy glycol Ester of oleyl alcohol

2.4 Amphoteric Surfactants.

These compounds are of comparatively recent development and are characterized by containing in their structure both acidic and basic functions which vary according to the pH

E.g. N-substituted amino acid derivatives (ß-alanines) made by condensation of fatty primary amines and acrylic monomers may be represented by

(I) N =fatty ß aminopropionate: $R.NHCH_2CH_2COOM$

Where R=fatty acid; M = cation of hydrogen

(II) N= fatty ß iminodipropionate: $RN\ (CH_2CH_2COGM)_2$

The amphoterism may be descirbed as follows:

Acid pH range Neutral pH range Basic pH range

$$RN^+H_2CH_2CH_2COOH \leftrightarrows RN^+H_2CH_2CH_2COO^- \leftrightarrows RNHCH_2CH_2COO^-$$

Cationic Amphoteric Anionic

In acid media the compounds are cationic and in alkaline media anionic.

3. Solubility & Surface Activity of Surfactants.

A Surfactant solute usually displays maximum surface activity and functional effectiveness when it is near the threshold of insolubility. Moreover the

solubility of surfactant is markedly affected by temperature and electrolyte concentrations. Thus for each set of conditions there is usually an optimum solubility balance for each type of surfactant. Relatively small changes in the composition of a surfactant are often sufficient to change its solubility and hence its surface activity. There are many ways to effect such changes, for example the average molecular weight of the raw material mixture i.e. hydrophobe can be increased slightly or the degree of sulfonation, sulfonation nation or ethoxylation can be increased or decreased. Empirical solubility tests rank with charge weights and chemical analysis as control techniques for surfactant manufacturing processes. They make it possible to produce to tight specifications by compensating for variations in successive lots of raw materials or to adjust a process to obtain a range of optimum performance conditions for essentially the same products but are pointed to different uses.

4. Wetting and detergent Structures in Surfactants

Correlation of functional properties with molecular structures have been sought by numerous investigators. One result has been the identification of strong wetting and strong detergent structure. The hydrophilic group of strong wetting agents is located at the middle of the hydrophobic chain or at the central branching point if the molecule contains two or more chains. Conversely the hydrophilic group in strong detergent is located at the end of the hydrophobic chain. This may be illustrated by comparing two isomers, sodium1 (n-butyle)-octyl sulphate and sodium n-dodecyl sulphate

Although the wetting and detersive properties of unformulated anionic and non-ionic compounds follow this structural pattern, usefulness of the

generalization is limited to the selection of the surfactants for a few specialized applications e.g. textile wetting agents. This limitation is due to the pronounced superiority of formulated or "built" products over pure compounds for detergency, emulsification etc. In formulation, detergency and wetting strength of individual components lose much of their significance. Textile wetting efficiency is not simply related to surface tension lowering, but dilute aqueous solutions of strong wetting agents characteristically have low surface tension.

5. Effect of surfactant on the properties of Solutions

A Surfactant changes the properties of a solvent in which it is dissolved to a much greater extent than would be expected from its concentration. This marked effect is due to

1. Adsorption at the solution interfaces,
2. Orientation of the adsorbed Surfactant ions of molecules
3. Miscelle formation in the bulk of the solution, and
4. Orientation of the surfactant ions or molecules in the micelles

These effects are caused by the amphipathic structure of a surfactant molecule and the magnitude of the effects depends to a large extent on the solubility balance of the molecule. An efficient surfactant is usually relatively insoluble as individual ions in the bulk of a solution.

6. Wetting characteristics of Surfactants

Wetting of a solid by a surfactant solution may represent either the displacement of air or some other gas from the solid surface by the solution of a liquid, e.g. an oil, from the solid surface. Wettability represents the tendency of a solid to be wetted and wetting power the tendency of a liquid to wet a solid. The wetting of one liquid by another immiscible liquid is visually apparent by the spreading of a film to create a large liquid-liquid interface, and lack of wetting is evidenced by the tendency of one liquid to form droplets in the form of lens on the surface of the other.

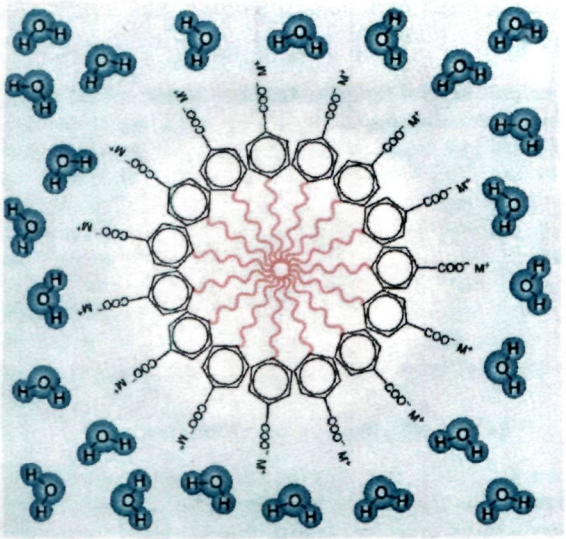
The attraction between a solid or liquid to be wetted and the wetting solution determines the degree or completeness of wetting that can be attained. In practical applications, the speed of wetting may be as important as the completeness of wetting at equilibrium.

Many investigators have pointed out that rate of migration of surfactant molecules from the bulk of the solution to maintain the concentration of the interface is one limiting factor on the speed of wetting. Dynamic methods for measurement of the lowering of surface, free energy have been used to estimate the significance of this factor. The effectiveness of mechanical agitation, thermal agitation or capillerity in bringing the solid or liquid to be wetted quickly into intimate contact with the wetting solution often influences the speed of wetting more than the migration rate of the surfactant.

7. Micellar Solubilization of Surfactants

The spontaneous dissolution of a normally insoluble substance by a relatively dilute solution of a surfactant is called **Solubilization**. The substance dissolved is referred to as the **Solubilizate** and the surfactant as the **"Solubilizer"**. There are no simple quantitative relationships between solubilizing power of a surfactant and the micellar or surface properties of its solutions. Solbilization is primarily a phenomenon of importance in dilute solutions. In more concentrated solutions it is some times difficult to distinguish between solubilization and cosolvency, which is a term applied to a mixture of solvents that takes into solution a higher concentration of solute than would be expected from the sum of their individual solubilizing powers. Solubilization does not introduce another phase and solutions containing solubilized material are thermodynamically stable. It is a reproducible phenomenon but the rates of attainment of equilibrium differ greatly when approached from different directions. Surfactants molecules or ions at concentrations above a minimum value characteristics of each solvent-solute system associate into aggregates called **micelles**. The term **critical miscelle concentration (CMC)** is used to denote the concentration at which micelles start to form in a system comprising solvents,

micelle



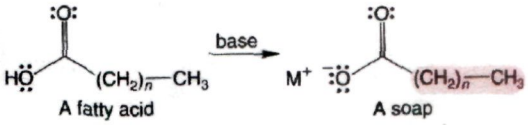


FIGURE 19.8 The formation of a soap from a fatty acid. In polar media, soaps form micelles, with the hydrophobic hydrocarbon chains directed toward the center of a sphere, away from the polar solvent. The surface of the sphere contains the polar carboxylate anions and their positive counterions.

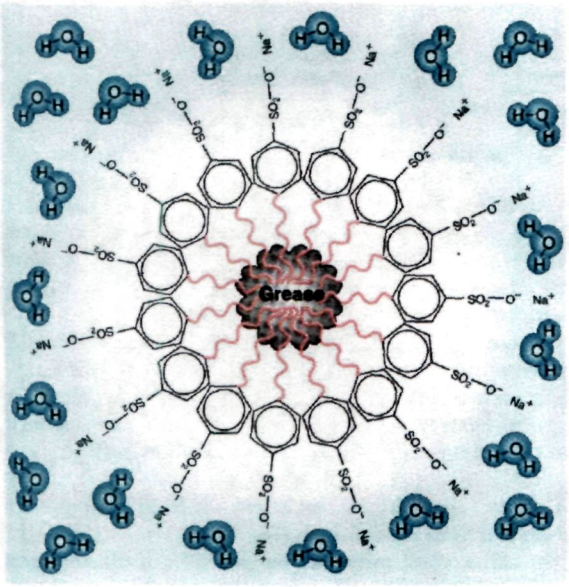


FIGURE 19.9 A micelle of a detergent solubilizing a grease molecule.

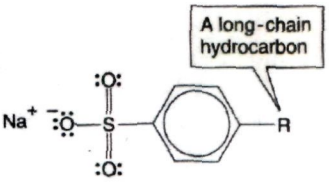


FIGURE 19.10 A synthetic soap, a detergent.

surfactants, possibly other solutes, and a defined physical environment. The CMC of surfactants in aqueous solutions depends on the structure of the compounds and the environment, but for many anionics at low electrolyte concentrations and room temperature it is close to 10^{-2} mols/litre, for non-ionic under comparable condition it is less about 10^{-4} moles/liter. In many surfactants where the hydrophilic group is unchanged but the size of the hydrophobic group is increased, CMC values decrease with increasing size of the hydrophobe for both ionic and nonionic types. If the hydrophobic group is held constant, CMC values decreases with decreasing ethylene oxide content of non-ionic. Increasing the electrolyte concentration decreases CMC values for both anionics and non-ionics. The CMC of anionic micelles increases as the temperature increases, whereas the CMC of nonionics decreases with the increase in temperature as would be expected from the cloud point phenomenon.

Solubilization is a micellar phenomenon that occurs only at concentrations above the CMC. It is of considerable importance in non-aqueous applications of surfactants particularly where water is the solubilizate. Typical applications are in dry cleaning solutions and engine lubricants. Essential oils, vitamins, cosmetic emollients, and textile mill processing oils are typical solubilizates in aqueous systems. Mixtures of surfactants are generally better solubilizers than the same surfactants used individually. Ionic-non-ionic combinations are especially effective.

8. Uses of surfactants

Household and personal products tend to dominate the literature on surfactant technology because the sales volume per product is large enough to support research and justify investments in manufacturing facilities. Industrial applications of surfactants usually represent a much smaller sales volume per item and the product research is often conducted either by the user or by a service company that supplies a variety of items to consuming industry. Criteria or methodology for selection of surfactants for screening in possible applications apparently has not been extensively studied.

8.1 Household and Personal Products

Detergency is the predominant function of household and personal products, and the trend since the decline of soap and the advent of synthetic detergents has been toward functional specialization. A list of the surfactant products now offered for home use confirms the effectiveness of this approach to improved performance viz., heavy duty laundry detergents, softening rinses, hard-dishwashing detergents, scouring powders, scouring pads, wall and floor cleaners, earwash detergents rug shampoos, wool detergents, fine fabric detergents, metal cleaners, wall paper removers, soap or detergent bars, hair shampoos, hair rinses, facial cleaning creams, dentifrices, waterless hand cleaners, herbicide and insecticide sprays, and furniture polishes. At one time most of these applications were all dependent on soap as the surface active agent.

8.2 Industrial uses

Surfactants are widely used outside of the household for cleaning and for many other purposes. Often the volume or cost of the surfactant consumed in an industrial process is small in compositions to the benefits derived from its use. The following list of surfactant applications by industries is indicative of the growing importance of this series of products.

8.2.1 Agriculture

Surfactants are used in phosphate fertilizers to shorten manufacturing cycle and prevent caking during storage. In spray application of herbicides, insecticides and fungicides, they are used in wetting, dispersing and suspending of powdered pesticides and emulsification of pesticide solutions to promote wetting, spreading and penetration of the toxicant.

8.2.2. Building and Construction

In paving, they prevent Stripping by improving the bond of asphalt to gravel and sand. Their use promote air entrainment in concrete for control of density, plasticity and insulating properties etc.

8.2.3 Elastomers and Plastics

In emulsion polymerization they effect the emulsification of monomers by solubilization of monomers and catalyst which react in surfactant micelles. They also help in stabilization of latexes. In foamed polymers, they effect the introduction of air and control of cell size. In latex adhesive they promote wetting and thus improve bond strength. In plastic articles, they are used as antistatic agents and in plastic coating and laminating they are used as wetting agents.

8.2.4 Food and Beverage

In food processing plants, they are used for cleaning and sanitizing walls, floors and process equipment. They give improved removal of pesticide residues and aid in wax coating of fruits and vegetables. In bakery products and ice creams, they solubilize flavor oil, control consistency and retard staling. In beverages, they solubilize flavor oils. In crystallization of sugar, they improve washing and reduce processing time. In frying with cooking fats and oils, they prevent spattering due to superheating and sudden volatilization of water.

8.2.5 Industrial Cleaning

In miscellaneous cleaning, janitorial supplies and clothes, they are used for cleaning and sanitizing walls, floors, windows, vehicles, engines etc. and as detergents for laundry and dry cleaning. In descaling, they are used as wetting agents and corrosion inhibitors in acid cleaning of boiler tubes and heat exchanges. In wax strippers, they are used to improve wetting and penetrations of the old finish.

8.2.6 Leather

In leather industry, they are used as detergent and emulsifier in degreasing skins, to promote wetting and penetration in tanning, as emulsifiers in fat liquoring of hides, to promote wetting, penetration and levelling in dyeing.

8.2.7 Metals

In concentration of ores, they are used for wetting and foaming i.e. collecting and frothing in ore flotation. In cutting and forming of metals, they are used for wetting, emulsification, lubrication and corrosion inhibition in rolling oils, drawing lubricants, buffing and grinding compounds. In casting, they are used as mold release additives. In rust and scale removal, they are used for wetting, foaming and corrosion inhibition in pickling and electrolytic cleaning. In electroplating they are used for wetting and foaming in electrolytic plating baths.

8.2.8 Paper

In pulp treatment, they are used for derinsification, pitch dispersion and washing. In paper machine, they are used for defoaming, felt washing colour levelling and dispersing. In calandering they are used for wetting and levelling in coating and colouring operations. In towel and pads, they are used for wetting to improve absorption of moisture.

8.2.9 Paints and Protective Coatings

In pigment preparation, they are used for flushing, i.e. promote preferential wetting by the paint vehicle, dispersing and wetting of the pigment during grinding. In latex paints, they are used to emulsify the oil or polymer, disperse the pigment, stabilize the latex, retard sedimentation and pigment separation, modify wetting and rheological properties. In waxes and polishes, they are used for emulsifying waxes stabilize emulsions and wet substrates in finishes for floor and automobiles.

8.2.10 Petroleum Production and Products

They are used in drilling fluids to emulsify oils, disperse solids, and modify rheological properties of drilling and completion fluids for oil and gas wells. In mist drilling, they are used to convert intrusion water to foam in air drilling. In work over of producing wells, they are used to emulsify and disperse, sludge and sediment in clean out of wells, modify wetting of formation at producing zone. In

producing wells, they are used to demulsify crude petroleum and inhibit corrosion of wells, tubing, storage tanks and pipelines. They are used for secondary recovery in flooding operations, to release crude oil from the formation surface, i.e. preferential wetting. Their application in refined petroleum products include as detergent sludge dispersant and corrosion inhibitor in fuel oil,. crankcase oils and turbine oils.

8.2.11 Textiles

In the preparation of fibers and filaments, they are used as detergent and emulsifier in raw-wool scouring; dispersant in viscose rayon spin baths; lubricant and antistat in spinning of hydrophobic filaments. In gray goods preparation, they are used for wetting and detergency in slashing and sizing formulations; wetting and detergency in kier boiling and bleaching of cotton, and carbonizing of wool; detergency in scouring piece goods; emulsification of processing oils. In dyeing and printing, they are used for wetting, penetration, solubilization, emulsification, dye levelling, detergency and dispersion. In finishing of textiles, they are used for wetting and emulsification in finishing formulations softening, lubricating and antistatic additives to finishes.

9. Biodegradability of surfactants and water pollution

The most important disadvantage of detergents in the environmental pollution caused by the factory refuse discharged to near by the factory refuse discharged to near by water sources.

Because of great attention being given to water pollution control in recent years, Scientists realized that surfactants being developed for use in household and industrial detergents which go down the drains to the sewer must be as readily decomposable by the microbial action of **sewage treatment and of surface streams as ordinary constituents of household wastes.** It is, therefore, necessary to take these factors into consideration while developing any new detergent product. There are some substances (surfactants), like tetra proylene derived alkyl benzene sulphonate (TPBS), which degrade slowly with persistent

residue, while others are more readily decomposable by microorganisms and leave no persistent residues. **Biodegradability is the ease with which a surfactant is decomposed by microbial action.** Tests as well as standards have been made for biodegradability. However, their standards are not much importance because of the fact that biodegradability depends mainly on environmental conditions. Materials which may be non-degradable in inefficient treatment can be completely decomposed by biological treatment systems. Taking all the facts into consideration, the most important step in detergent industry is a substitution for tetra propylene benzene sulphonate (TPBS), which has widely been used as detergent raw material. It is used in household dishwashing and laundry products. TPBS can be prepared by alkylting benzene with propylene tetramer, followed by sulphonation of the benzene ring. The propylene tetramer consists of multitude of **branched isomers** with little, if any, straight chain alkyl groups.

It has now been found that straight chain material gives readily degradable detergent and fit easily into the detergent formulation in which it will replace TPBS. More readily degradable surfactant has actually developed a straight chain hydrocarbon to make the alkyl benzene.

In order to improve biodegradability of detergents scientists have attempted to supplant the various branched chain alkyl benzene (e.g. TPBS), by straight chain alkyl products. These are to be sulphonated after being made into normal or straight chain alkyl benzenes.

10. Strategies for avoiding Surfactants

Our body has lots of surfaces from external skin right down to the level of cell membranes. These surfaces are powerful biological organs, permeable to the 'right' compounds, actively transporting, actively defending, and containing and allowing diffusion.

Surfactants disrupt and modify all types of surfaces. They are called soaps, detergents, conditioners, emulsifiers and solvents. They are found in soaps & shower gels, household and industrial cleaners, shampoos, hair conditioners,

toothpaste, cosmetics, processed foods, aerosols, liquid fuels, paints, polluted air, etc.

If you allow any of these compounds onto, or into yourself, you will disrupt the functioning of vital surfaces and impair your health. Long-term use of these chemicals will cause a reduced life span and chronic illness.

10.1 Toothpaste

This has been with us since the development of that ubiquitous detergent... sodium lauryl sulphate. Toothpaste is vigorously marketed by models with gleaming teeth, living glorious lives and by funny cartoon figures. It is, according to the advertising, a magic shield...fending off the nasty germs, adding minerals to our teeth, providing a 24-hour sentry in our mouths, and cleaning them as well. Toothpaste does do some good things. It removes leftover food and plaque from your teeth and prevents bacteria building up. The mineral in it may be good for some people who are deficient in them due to poor diet or constitution (they should change their diet to an ayurvedic one and/or improve their constitutions with Yoga). Now the bad news... the chemical (fluorides & phosphates) and the detergent (detergent= sodium lauryl sulphate), attack the surfaces lining the respiratory system and digestive system when inserted in your mouth. After many years of repeacted assault the immune system becomes over-sensitized and when the toothpaste is used an allergic reaction can result. Every one will suffer immune system damage. Use barley flour and sodium bicarbonate 75:25 to clean your teeth.

10.2 Soap

Do not fooled by modern advertizing, which promotes soap-less body cleaners. These are just detergents of some sort even though there is no 'soap' in them.

These sodium salts of fatty acids are widely used on the external skin. They remove the layer of essential fatty acids on the surface of the skin and destroy the integrity of the skin, making it more permeable and developing cracks. The

hands are especially vulnerable. The immune system is overtaxed dealing with the problem. Clean up your diet and get rid of all stale food, this will eliminate the toxins that are normally excreted through the skin and you will not get that sticky, dirty feeling. You will not need to scrub off these toxins with soap. Mechanics and gardeners can rub vegetable oil into their hands to dissolve oils and grime and then wipe with a paper towel.

Use barley flour, like talcum powder, on grimy spots and then shower. Use a body brush in the shower to gently massage the skin. Use cold pressed organic sesame oil or ghee massaged on the skin after washing.

10.3 Detergents

Take great care that these do not contact your body by using rubber gloves and protective clothing. When taking off the gloves wash them in clean water first so that nothing gets on your hands when you remove them. Turn them inside out as they come off so that they dry out and the detergent contaminated surface is inside. Turn them back the right way by inflating them with a puff from the lungs. If there is a leak or you allow detergent inside the glove, immediately remove it and replace the glove and wash as appropriate.

10.4 Shampoo and Body Gels

These are made from a detergent called sodium lauryl sulphate (see Toothpaste). Replace by massaging barley flour into your hair to remove excess oil and then wash with warm water. Brush with a soft brush and anoint with coconut oil if dry. Your naturopath may have hair tonics containing beneficial herbs if necessary.

10.5 Conditioners

These are emulsions of detergents attached to oil molecules. They damage the skin as shampoo does and in addition leave behind an oily layer on the skin and hair. This oil is not the 'right' one for your skin. Only cold pressed veggie oils

and ghee should be used on the body. Coconut oil in small amounts should be rubbed in the hair. See Shampoo

10.6 Cosmetics

These contain mixtures of oil, water and emulsifiers (e.g. Hand cream). The oil will not be 'right' and the emulsifiers are toxic. Clean up your diet, use only cold pressed sesame oil and / or clarified butter, get rid of soap, and your skin will be like a baby's. For even better skin perform amaroli.

10.7 Emulsifiers and Processed Foods

Many processed foods contain emulsifiers to stabilize them and prevent separation in storage. These compounds interfere with the digestive system and lining, causing indigestion. Toxins enter the body and tax the immune system. Eat only fresh organic foods, in accord with your nature and processed by a trained Ayurvedic cook just before eating.

10.8 Solvents

Whenever you need to use any hydrocarbon solvents, such as aerosols (powered by butane), fuels, Paints etc. then take precautions so that they do not touch your skin and the fumes do not go into your lungs. Change to water based products. Use gloves and breathing equipment.

11. Detergents

We know that soap lowers the surface tension of water and lowering in surface tension can be easily effected by dissolving soap in water. This property of soap is an important factor in its cleaning action. There is another important property of soap solutions which plays most important part in the cleaning action. This property is of emulsifying oils and fats.

In the light of two important properties, just given of the cleaning power of soap, attempts were made in Germany and other countries, owing to a shortage of fats during world war I to produce other substances called Detergents, very

different in chemical nature from an ordinary soap or salt of a fatty acid. For example, some acids were first prepared by the action of sulphuric acid on higher unsaturated hydrocarbons containing 10-18 carbon atoms, The sodium salts of these acids were found to reduce the surface tension of water and to have valuable wetting and detergent properties.

" A detergent may be regarded as a chemical formation which essentially consists of surface active agents or surfactants and subsidiary constituents such as fillers, builders, boosters etc."

The detergent may be in the form of solid, liquid, paste or powder.

Synthetic detergents as well as wetting agents of varied chemical nature and with properties which make them specially suitable for specific purposes, are now being manufactured. They find extensive use, not only as detergent substitutes for soaps, but also as wetting agents in dyeing to increase the effectiveness of insecticides spray and for many other purposed. A large amount of edible oils and fats, which is being consumed in manufacture of soap, has now become available for human consumption by the introduction of soapless detergents. In general, the synthetic detergent is used to indicate a synthetic material which is used to indicate a synthetic material which is used for cleaning and usually does not include soap. The cleaning action of surface-active agents (present in detergents) depends upon the property of decreasing surface tension or interfacial tension at the boundary surface between two phases of matter (liquid-gas or liquid-liquid)

The most important advantages of the synthetic detergent is better wetting and cleaning action and consumption by hard water, because of higher solubility of their Ca^{2+} and Mg^{2+} ions.

12. Principal groups of Synthetic Detergents

Synthetic detergents, like soap, are compounds, which have a tendency to dissolve in water and also in oils and other non-aqueous materials under certain conditions. Hence most of them are a combination of water attracting, or **hydrophilic groups** on one end of the molecule, with water repelling or

hydrophobic groups, on the other. The hydrophilic or water attracting groups make the compound soluble in water, whereas hydrophobic or water repelling groups make the compound oil soluble.

When detergent is added to water containing some non-aqueous material, such as oil, the molecules of the surface active agent orient themselves in such a manner that the hydrophilic or water loving groups projects in water and hydrophobic or water hating group dissolves in the oil. As a result, interfacial tension between water and oil is reduced and an emulsion is produced when such a mixture is shaken.

In many cases, the hydrophilic group is usually introduced synthetically to a hydrophilic material in order to get a compound which is soluble in water. For example, lauryl alcohol ($CH_3(CH_2)_{10}CH_2OH$ almost insoluble in water, but when it is sulphonated, the resulting product $CH_3(CH_2)_{10}CH_2OSO_2OH$ is soluble in all proportions. The alkali salt of it is a good detergent.

It should, however, be noted that the formation of detergent does not depend upon the solubility but on the ratio of the molecular weight of the hydrophobic to that of hydrophilic part of the molecule. For example, detergent formed by the action of 10 molecules of ethylene oxide on lauryl alcohol is soluble in water and is a good detergent, but the same compound formed by the action of 5 molecules of ethylene oxide on lauryl alcohol is neither soluble in water nor a good detergent.

13 Classifications of Detergents

13.1 Anionic Detergents: are those whose detergent property is due to these anions in the solution. In order to develop full detergency in the compounds, the anions are neutralized with an alkaline or basic material.

Anionic detergents dissociate into a long chain anion which acts as the hydrophilic end, and the long carbon chain as the hydrophobic end.

Example: Sulphated fatty alcohols

Alkyl benzene Sulphonates(ABS)

The sulphated products are stable in hard water, but pH sensitive in acidic and alkaline medium.

13.2 Cationic Detergents

Cationic detergents are those whose detergent property is due to the presence of cations in solution.

Cationic detergents are tetra alkyl ammonium salts with a long chain hydrocarbon part which acts as hydrophobic end and cataionic nitrogen constitutes the hydrophilic end. Cationic detergents are not important as detergents and have applications as fabric softeners, antibacterials and aligicidal agents.

Example: Amine acetates

Alkyl trimehyl ammonium chloride

13.3 Non – Ionic Detergents

Non-ionic detergents do not contain any ionic molecule. Non-ionic detergents are polyethylene oxide derivatives having the composition

$R\text{-}X\text{-}CH_2\text{-}CH_2\text{-}(O\text{-}CH_2\text{-}CH_2)_n\text{-}OH$

Where,

X= -O- , -COO, -N-, -S-, -C-N- etc

‖

O

In these detergents, the hydrocarbon part is hydrophobic and alcoholic part is hydrophilic. The alcoholic part undergoes solvation with water through hydrogen bonding. These detergents are used as grease emulsifiers.

Example: Ethylene oxide condensates of alkyl phenols.

Fatty amine oxides

13.4 Amophoteric Detergents

Amphoteric detergents contain both acidic as well as basic groups in the same molecule. These detergents are used in the manufacture of toothpaste, shampoos, cosmetics and water emulsion paints. Example: sodium lauryl sarcosinate or deriphat.

14.SUBSIDIARY CONSTITUENTS OF DETERGENTS

14.1 BUILDER

The builder is the second most important ingredient in a detergent formula because it enhances or "builds" the cleaning efficiency of the surfactant by inactivating water hardness minerals.

Builders provide one or more of the following functions:

- Soften water by trying up water hardness
- Help prevent water hardness ions from interacting with negatively charged surfactants so surfactants can concentrate on soil removal
- Increase the efficiency of the surfactant system
- Most provide a desirable level of alkalinity, which aids cleaning
- Most disperse and suspend soils and prevent their redeposition

Builders are used in general purpose laundry powders and liquids but not in light duty detergents (powders and liquids). Most general purpose liquids contain builders such as citrate, but some are unbuilt. The unbuilt liquids use surfactants which are less hardness sensitive, instead of including a builder to minimize interactions with water hardness minerals. The general purpose liquids should not be confused with light duty liquids, which are designed primarily for washing dishes by hand.

Builders soften water by sequestration, precipitation or ion exchange.

14.1.1 Sequestering Builders

Sequestering builders, such as polyphosphates, inactivate water hardness mineral ions and hold them tightly in solutions. Another builder, citrate, while not

as strong a sequestrant as phosphate, contributes to detergency performance in some types of heavy duty liquid detergents.

14.1.2 Precipitating Builders

A precipitating builder, such as sodium carbonate or sodium silicate, removes water hardness ions by a nonreversible reaction, forming an insoluble substance or precipitant. They are especially effective on calcium ions.

14.1.3 Ion Exchange Builders

An ion exchange builder, such as alumino silicate (zeolite) , is an insoluble material which ties up calcium hardness minerals.

14.2 ADDITIONAL INGREDIENTS

14.2.1 Antiredeposition Agents

Anti redeposition agents may be made from complex cellulosic materials such as carboxy methyl cellulose (CMC),
or synthetic materials such as polyethylene glycol and polyacrylates. They aid in preventing loosened soil from redeposition onto cleaned fabrics. Polyphosphate builders also help in reducing redeposition.
Light duty liquids designed for hand dishwashing do not contain antiredeposition agents.

14.2.2 Corrosion Inhibitor

Corrosion inhibitor, usually sodium silicate, helps protect washer parts from corrosion.
Light duty liquids designed for hand dishwashing do not contain corrosion inhibitors as they are not intended for use in a washing machine.

14.2.3 Fluorescent Whitening Agents

Fluorescent whitening agents (FWAs or brighteners) are complex organic molecules which adhere to fabrics as though they were dyes. Ultraviolet energy is absorbed, converted and emitted as visible blue light to enhance fabric appearance and maintain whiteness or brightness. The light duty liquids designed for hand dishwashing do not contain FWAs.

14.2.4 Processing Aids

Processing aids cover a considerable list of ingredients such as sodium sulfate, water, solvents like alcohol, or xylene sulfonate . They provide the product with the right physical properties for its intended use. Sodium sulfate, for example, helps provide crisp, free-flowing powders. Alcohols are often used in liquid products where they serve as solvents for the detergent ingredients, adjust the viscosity and prevent product seperation. Since the water content of liquids is fairly high,
alcohols also provide protection to the product under extremely cold storage conditions by lowering the freezing point.

14.2.5 Colorants

Colorants are added to lend an individuality to the product or dramatize a special additive contributing to product performance. Additionally, blue colorants may provide a bluing which imparts a desirable blue/white color to white fabrics.

14.2.6 Fragrances

Fragrances provide three functions, regardless of the scent used. They cover the chemical odor of the detergent and the odor of soils in the washing solution. Plus, they impart a pleasant scent to fabrics, thus reinforcing the clean performance.
Additionally, a fragrance contributes to the character of the product. Some detergents are offered in unscented versions, appealing to consumers who prefer low or no scent on laundry. They may also appeal to people whose skin is sensitive to fragrance ingredients.

14.2.7 Opacifiers

Opacifiers are used in some liquid products to provide a rich, creamy, opaque appearance.

14.2.8 Oxygen Bleach

Oxygen bleach provides the detergent with an all-fabric bleaching action for stain and soil removal. The most common agent used is sodium perboratetetrahydrate, but sodium percarbonate can be used.

Recently, activated bleach systems have been introduced that provide effective fabric whitening at today's lower wash temperatures.

14.2.9 Enzymes

Enzymes aid in breaking down complex soils, especially proteins such as grass and blood, so that these soils can be more easily removed by other detergent ingredients.

14.2.10 Suds Control Agents

Suds control agents are used as suds stabilizers or suppressors Suds stabilizers are limited to detergents, such as light duty products, where lasting, voluminous suds are desirable. Suds suppressors inhibit sudsing or control it at a low level. Special long chain soaps are one class of compounds used to control sudsing in powder and liquid laundry detergents.

14.2.11 Fabric Softening Agents

Fabric softening agents imparts softness and control static electricity in fabrics. Cationic surfactants (e.g., quaternary ammonium compounds) are commonly used.

14.2.12 Other Ingredients

Other ingredients may be added to a laundry detergent system to provide specialized performance or convenience.

15 Advantages of Detergents over Soaps

Although soap still continues to be an important surface active agent for a host of household and industrial applications, the demand for various synthetic detergents has lately risen considerably in the world market and these are manufactured and sold on commercial scale in constantly increasing quantities.This global performance for synthetic detergents may be attributed to the following distinct advantages which can be obtained by their use:

15.1 They can be specially formulated to meet the different detergency loads while the soap is comparatively fixed in composition by the natural distribution of fatty acids in oil and fats.

15.2 They are more or less equally effective in both hard and soft water while common soap is rather inefficient in hard waters.

15.3 Being available in powder or liquid forms, they dissolve easily in water requiring lesser efforts in washing clothes, especially the synthetic fibre clothes, as compared to the laundry soap bars.

15.4 Being based on chemical raw materials rather than naturally occurring oils, their production can always be increased to meet the demand. This is particulary more so in the Indian context where the various fatty oils, notably the edible oils need be conserved for use in other purposes.

16. CONCLUSION

As water, the liquid commonly used for cleaning, has a property called surface tension. This tension causes water to bead up on surfaces which slows wetting of the surface and inhibits the cleaning process. In the cleaning process, surface tension must be reduced so water can spread and wet surfaces. Thus, there are chemicals that are able to do this effectively and are called surface

active agents or surfactants. Surfactants, in general, have some or all the following properties: wetting out, dispersing, emulsifying, penetrating and cleaning. Soap is the oldest, the best known, and still the most commonly used surface-active agent. Soap has been the main cleansing agent for centuries. However, within the past fifty years or so, considerable effort and research have been directed to the development of surfactants to perform specific tasks and with a view to overcome the limitations of soaps, particularly in hard water and in the presence of high salt concentrations.

The earliest of the synthetic detergents to invade the commercial field were the sodium salts of the higher alcohol sulfates, which has many of the properties of soap. They compared well, as far as detergency, wetting and foaming power were concerned; and in addition their calcium and magnesium salts were water soluble and did not precipitate from hard water solutions. Then the alkyl aryl sulfonates were introduced, they were stable in hard water and acid solutions, had excellent detergent and wetting properties, and were manufactured from low priced petroleum, rather than the costlier vegetable oils necessary to produce the higher alcohol sulfates.

The most important disadvantage of detergents is the environmental pollution caused by the factory refuse discharged to nearby water resources. In order to improve the biodegradability of detergents, scientist have attempted to supplant the various branched chain alkyl benzenes (e.g .TPBS), by straight chain alkyl products.

CHAPTER - III

OBJECTIVES AND METHODOLOGY OF BIBLIOMETRIC STUDY

Due to the multidimensional growth of knowledge Librarians and Information Scientists are facing great problem in acquisition, organization and dissemination of information. In view of information explosion the acquisition and organization of information is a challenge for the librarians. Because libraries are labour intensive organization, it is necessary to have need-based collection to meet the requirements of maximum number of library users within limited resource.

Prof. Bernal has reported that literature growth is six folds more than the population growth and if some method is not introduced it will lead towards the literature deluge.

Due to the huge amount of literature and limited financial resources it is rather impossible to acquire everything. The document selection must be done according to the information needs of users. For this purpose librarians have conducted a number of user studies that study the use of information by reader. User studies can be done in two ways:

a) In terms of information and its user and

b) In terms of user and his information

The first kind of study is the analysis through its artifacts. Britain calls this study as the 'systematic' approach to study the use of literature. In 1963 Pritchard introduced the term 'Bibliometrics' to this study, which is now one of the well-recognized and dependable technique for research in the field of library and information science.

1. OBJECTIVES

1.1) To find out the most used pattern of different types of documents i.e. books, journals, reports, standards, patents etc.

1.2) To know about the use of literature from different countries to find out the country producing most of the literature.

1.3) To know the most productive year / years of the literature published on the subject.

1.4) To find out the most dominating language(s) in which the most of the articles on the subject have been produced.

1.5) To know the core periodicals containing the most of the published literature

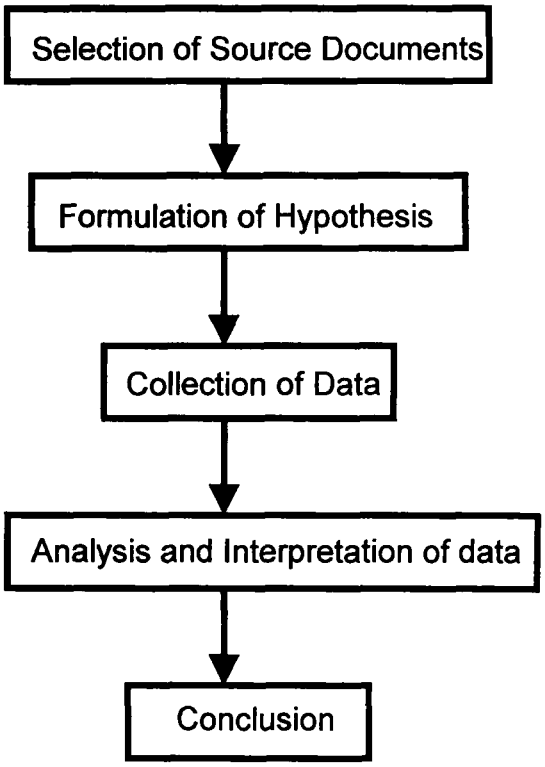
1.6) To know eminent personalities in the field of Surfactants and detergents.

1.7) To study the rate of collaborative research that can be effectively measured from the number of authors in papers.

1.8) To show the interdisciplinary character of the subject under study.

2. METHODOLOGY OF BIBLIOMETRICS

We can discuss the methodology of Bibliometrics under the following points:



2.1 Selection of Source Document

The first and foremost task is to select the source document from which data is to be drawn. Chemical Abstract, which is published by American Chemical Society, U.S.A. since 1907, is the most authoritative and comprehensive source material on the subject. I have scanned two volumes of Chemical Abstract for the year 1999-2000 to collect 5075 references on the subject 'Surfactants and Detergents'.

As in the literature mostly the word Surfactants have been used for Surface Active Agents. Therefore I have modified the title as Surfactants and Detergents

Chemical Abstract is found to be most comprehensive guide to the chemical literature of the world.

Due to the rapid growth of the list of source journals and due to the geographic and linguistic bias data has been collected from the secondary source like Chemical Abstract instead of any primary source.

For this purpose I have chosen two volumes of Chemical Abstract (i.e. 1999, 2000) as the source document.

2.2 Formulation of Hypothesis

Hypothesis is the tentative generalization of the problem. One should be very careful during the Formulation of Hypothesis because result of the problem completely depends upon it, otherwise it will lead to the wrong conclusion.

Regarding the present problem of Bibliometric study, Hypothesis, which I have drawn, is given below:

2.2.1 Patents may be the most used form of document.

2.2.2 There will be great influence of team research in the field of Surfactants and Detergents

2.2.3 There will be significant difference among countries regarding Geographical Scattering of articles in the field of Surfactants and Detergents.

2.2.4 English language will be the most used language by the authors for writing articles in the field of 'Surfactants and Detergents '.

2.2.5 Research output in 'Surfactants and Detergents' is increasing year by year.

2.3 Collection of Data

Data pertaining to the field of 'Surfactants and Detergents' was collected from Chemical Abs tract on 5 x 3 catalogue cards. Each reference consisted of information about author, title, name of periodical, place, year, language and form of document. In other words, we can say that a bibliography was created on cards and these cards are arranged and rearranged during the analysis.

2.4 Analysis

The data consisting of 5075 entries was collected and analyzed under the following headings:

2.4.1 Ranking of Periodicals

2.4.2 Geographical Scattering of Items

2.4.3 Year wise Distribution of Items

2.4.4 Language wise Distribution of items

2.4.5 Subject Dispersion

2.4.6 Form wise Distribution

2.4.7 Ranking of Authors

2.4.8 Application of Bibliometric Laws

2.4.1 Ranking of Periodicals

The main objective of this study is to find out the core periodicals containing the research literature on Surfactants and Detergents. To conduct this study, the items published in different periodicals are grouped together and counted.

Information about the most productive periodicals on the subject is much useful for the librarians as well as for research scholars. After the identification of core periodicals in the field, ranking of periodicals is done and tabulated.

2.4.2 Geographical Scattering of Items

This is done to determine the geographical scattering of item while studying the use pattern of research literature in the subject under study. The information was collected from the informative abstract of each item, which clearly gives the place of origin of each item. The entries were then grouped on the basis of their country of origin. They were then counted and ranked in a table.

2.4.3 Year wise Distribution of Items

With the help of this study, currency of information in the secondary source may be useful in finding out the most productive year of items ranked. Through this study we know that how many articles were published in which year. The information about the period of origin of the item can be easily known by the bibliographic information given in Chemical Abstract.

2.4.4 Language wise Distribution

It is also important to know the most dominant language used in scientific communication on the subject, because Chemiical Abstract reports items published from different countries in different languages. This information given along with informative abstract in the Chemical Abstract is analyzed and tabulated.

2.4.5 Subject Dispersion

Though most of the literature on a given subject is published in some core journals but sometimes some material of research value is published in the journals belonging to related fields. It is, therefore, important to know the interdisciplinary nature of the subject. Subject dispersion analysis is done on the basis of subject field of periodicals, the information about which was obtained

from Ulrich International Periodical Directory (33rd ed.). The analysis not only identifies the core subjects where most of the articles on the subject Surfactants and Detergents are published but also the subject publishing some relevant information. Thus, it will show the interdisciplinary nature of the subject.

2.4.6 Form wise Distribution

Document on any subject are published in different forms like periodical articles, research reports, bulletins and patents. It is important to know the most popular form of document. For this purpose, the information about the form document was collected and tabulated.

2.4.7 Ranking of Authors

This is done to know the eminent personalities in the subject. The data cards of different contributors in the field were separated out. The number of cards under each name were counted and tabulated. Authors are then ranked in order of decreasing productivity.

2.4.8 Application of Bibliometric Laws

The whole study depends upon the application of bibliometric laws such as Lotka, Bradford and Zipf's Law. For checking the validity of these laws, they will be individually applied on the analyzed data.

CHAPTER - IV

DATA ANALYSIS, INTERPRETATION AND PRESENTATION

Two volumes of Chemical Abstract for the year 1999-2000 were consulted for collecting a total of 5075 data items. The volume of 1999 contained 2368 items and the volume of 2000 contained 2707 items. Collected data was analyzed as under:

1. Ranking of Periodicals:

Periodicals play a vital role in scientific communication as well as for dissemination of information because periodicals are the sources of current information. Periodicals that contribute most of the literature in every subject field are called core journals. Identification of core journals in the subject under study will be useful from the point of view of scientists and librarians alike.

The main aim of the present study is to identify the most important journal containing the most of the literature of research value in the field of Surfactants and Detergents. This information of core journals in various subjects will go a long way in preparing the subscription list of periodicals by libraries. The information is useful for the information scientists as well.

In the collected data, all the 5075 references have been published in 405 periodicals and by 20 patents organizations which have been ranked upto 33 positions. However, the Table – 1 lists only 178 periodicals, showing 32 rank positions. These are periodicals in which frequency of occurrence of items is upto 2. The periodicals with less than 2 items have not been considered. Table – 1 shows that the first rank was occupied by the journal "Riyong Huaxue Gongye" which accounts for 1.71% of total references. Next four positions are occupied by the journals like 'Journal of Surfactants and Detergents' (1.30%), 'Surfactant Science Series' (1.12%), 'Communication Journal of Commercial Detergents' (0.82%) and Jingxi Huagong (0.76%) respectively.

10.57% of the total, appeared in those periodicals. They may be regarded as core journals in the field.

The references having their frequency of occurrence in the range of 10 – 29 are 16, those, in the range of 3 – 9 is 74 and in the range of 1 – 2 is 316. It is therefore, obvious that though most of the literature constituting 10.57 appeared in 12 periodicals, the number of periodicals had been increasing for finding out much less number of items i.e. as many as 74 periodicals are required for 6.79% of items. This is in accordance with Bradford's Law of Scattering.

The present ranking list should be of use for the libraries in taking policy decisions regarding the subscription list of periodicals. It will be equally important for the documentalists in preparing an exhaustive documentation list. The study may be useful for the scientists, as they know the core journals carrying the highest percentage of items.

TABLE – 1

RANKING OF PERIODICALS

S. No.	Rank	Name of Periodicals	Frequency	%Frequency
1	1	Jpn. Kokai Tokyo koho JP	1282	25.26
2	2	Pct. Int. Appl. WO	993	19.56
3	3	U.S. U.S	387	7.62
4	4	Faming Zhuanli Shenqing Gongkai Shuomingshu CN	298	5.87
5	5	Ger. Offen DE	261	5.14
6	6	Eur. Pat. Appl.	221	4.35
7	7	Republic Korea KR	163	3.21
8	8	Riyong Huaxue Gongye	87	1.71
9	9	Journal of Surfactants and Detergents	66	1.30
10	10	Surfactant Science Series	57	1.12
11	11	Russian RU	44	0.86
12	12	Communication Journal of Commercial Detergent	42	0.82
13	13	Rome RO	39	0.76
14	13	Jingxi Huagong	39	0.76
15	14	Tenside Surfactants Detergents	36	0.70
16	15	Langmuir	35	0.68
17	16	Proceedings of world conference on Detergents : Srategies for 21st century	31	0.61
18	16	Colloids and Surfaces	31	0.61
19	17	Nihon Yukagakkaishi	30	0.59
20	18	Britain UK Pat. Appl. GB	29	0.57
21	19	Canadian Pat . Appl. CA	17	0.33
22	20	Annual Surfactants Review	16	0.31
23	21	Riv. Ital Sostanze Greasse	14	0.27
24	21	Journal of Dispersion Science & Technology	14	0.27
25	21	France. Demande FR.	14	0.27
26	22	Spec. Publ-R. Soc. Chem.	13	0.25
27	23	Huaxue Shijie	12	0.23
28	23	Colloid & Polymer Science	12	0.23
29	24	Analytical Chimica Acta	10	0.19
30	24	Alkyl Polyglycosides	10	0.19
31	24	Braz Pedido Pl BR	10	0.19
32	24	Przemysl Chemicz	10	0.19

33	24	Res. Disel	10	0.19
34	24	Surfactants	10	0.19
35	25	Journal of Chromatography A	9	0.17
36	25	Journal of Colloid Interface Science	9	0.17
37	26	Journal of Physical Chemistry B	8	0.15
38	26	Chimica Oggi	8	0.15
39	26	Colloidal Journal.of the USSR	8	0.15
40	26	SOFW Journal	8	0.15
41	26	Huaxue Qingxi	8	0.15
42	26	Huagong Shikan	8	0.15
43	27	ACS Symposium Series	7	0.13
44	27	Polymer Preprints.	7	0.13
45	27	Span. ES	7	0.13
46	27	Industrial Engineering and Chemical Research	7	0.13
47	28	Applied Organometallic Chemistry	6	0.11
48	28	Proc. World Conf. Palm Coconut Oils 21st Century1998	6	0.11
49	28	Fenxi Hauxue	6	0.11
50	28	Journal of Inclusion Phenomena and Macrocyclic Chemistry	6	0.11
51	28	Xiandai Huagong	6	0.11
52	28	Guangdong Huagong		0.11
53	28	Dissertation Abstracts International B	6	0.11
54	28	Kongop Hwahak	6	0.11
55	28	Shanghai Huagong	6	0.11
56	28	Huagong Jinzhan	6	0.11
57	28	Bunseki Kagaku	5	0.09
58	29	Progress in Colloid and Polymer Science.	5	0.09
59	29	Prog. Trends Rheon V Proc. Eur. Rheol. Conf. 5th	5	0.09
60	29	Fresenius Journal of Analytical Chemistry	5	0.09
61	29	Journal of Fluorine Chemistry	5	0.09
62	29	Uzb. Khim Zh.	5	0.09
63	29	Chromatographia	5	0.09
64	29	Olaj, Swappan, kozmet	5	0.09
65	29	Zh. Prikl. Khim	5	0.09
66	29	Info Chim Mag.	5	0.09
67	30	Analytical Chemistry	4	0.07
68	30	Analytical Sciences	4	0.07

69	30	Bol. INTEXTER Inst. Invest Text Coop Ind.	4	0.07
70	30	Pol. PL	4	0.07
71	30	Polymer	4	0.07
72	30	Rapid Commun Mass spectrum	4	0.07
73	30	Recent Research and Development in Pure and Applied Analytical Chemistry	4	0.07
74	30	Jiemian Kexue Huizhi	4	0.07
75	30	Wuli Huaxue Xuebao	4	0.07
76	30	Talanta	4	0.07
77	30	Text. Chem. Color. Am. Dyest. Rep.	4	0.07
78	30	Khim. Prom-St. (Moscow)	4	0.07
79	30	Mater. Technology	4	0.07
80	30	Hyomen	4	0.07
81	30	Henan Huagong	4	0.07
82	31	Analytical Science and Technology	3	0.05
83	31	Book-Pap-Int Conf. Exhib, AATCC	3	0.05
84	31	Pat Specif. (Aust.)	3	0.05
85	31	Pige Huagong	3	0.05
86	31	Rev. Chemical Engineering.	3	0.05
87	31	Rev. Roum Chem.	3	0.05
88	31	Feijinshukuang	3	0.05
89	31	Journal of Analytical Chemistry	3	0.05
90	31	Journal of Chemical Technology and Biotechnology	3	0.05
91	31	Current Topic in Colloid and Interface Science.	3	0.05
92	31	Yokohoma-shiritsu Daigaku Ranso, shizen kagaku keiretsu	3	0.05
93	31	Vestsi Nats. Akad Naunk Belarusi, Ser. Khim. Naunk	3	0.05
94	31	Chim Chemical Letters	3	0.05
95	31	Grasas Aceites (Sevilla)	3	0.05
96	31	Guangzhou Huagong		0.05
97	31	Ger. Gebrauchsmusterschrift DE	3	0.05
98	31	Wuxi Qinggong Daxue Xuebao	3	0.05
99	31	Zairyo Gijutsu	3	0.05
100	31	Tianran Chanwu Yanjin Yu Kaifa	3	0.05
101	31	Kagaku to Kogyo (osaka)	3	0.05
102	31	Sepu	3	0.05
103	31	Indian Journal of Chemistry:	3	0.05

		Section A		
104	31	Izv. Vyssh. Uchebn. Zaved.,Khim	3	0.05
105	31	Huanan Ligong Danue Xuebao, Ziram Kexueban Huadong	3	0.05
106	31	Huaxue Yanjiu Yu Yingyong	3	0.05
107	31	Huadong Ligong Daxue Xuebao	3	0.05
108	31	Current Opinion in Colloid and Interface Science.	3	0.05
109	32	Analytical Taschenb	2	0.03
110	32	Asian Journal of Chemistry	2	0.03
111	32	ASTM Spec. Tech. Publications	2	0.03
112	32	Actualite Chimique	2	0.03
113	32	Adsorption Science and Technology	2	0.03
114	32	Angewandte Chemie: International Edition.	2	0.03
115	32	Applied Catalysis A	2	0.03
116	32	Analyst	2	0.03
117	32	Ariake Kogyo Koto Senmon Gakko Kiyo	2	0.03
118	32	Bulletin of Chemical Society of Japan	2	0.03
119	32	Electrophoresis	2	0.03
120	32	Europhysics News	2	0.03
121	32	Europhysics Letters	2	0.03
122	32	Electroanalysis	2	0.03
123	32	Eco. Ind.	2	0.03
124	32	Polymeric Materials Science and Engineering	2	0.03
125	32	Polyurethanes Expo '98 Proceedings	2	0.03
126	32	Physics of Condens Matter	2	0.03
127	32	Physica B	2	0.03
128	32	Risoe Natt. Lab.,(Rep.)Risoe	2	0.03
129	32	Proceedings of International Symposium on Cyclodextrins, 9th 1998	2	0.03
130	32	Rheol. Ser.	2	0.03
131	32	Fibres Text. East. Eur	2	0.03
132	32	Fangzhi Xuebao	2	0.03
133	32	Fett/ Lipid	2	0.03
134	32	Journal of Applied Polymer Science.	2	0.03
135	32	Journal of High Resolution Chromatography	2	0.03

136	32	Journal of Therm.Anal.Calorim	2	0.03
137	32	Journal of Mass Spectrometry	2	0.03
138	32	Journal of Macromolecular Science	2	0.03
139	32	Journal of Oil Palm Research	2	0.03
140	32	Ukr. Fiz Zh.	2	0.03
141	32	Chemik	2	0.03
142	32	Carbohydrate Polymers	2	0.03
143	32	Chemicke Listy	2	0.03
144	32	Chemosphere	2	0.03
145	32	Chemical Engineering and Technology	2	0.03
146	32	Chemical and Environmental Research	2	0.03
147	32	Chemical Letters	2	0.03
148	32	Chemical Analysis(Warsaw)	2	0.03
149	32	Chinese Journal Of Chemistry	2	0.03
150	32	Chim. Ind (Milan)	2	0.03
151	32	Cailiao Baohu	2	0.03
152	32	Gaofenzi Xuebao	2	0.03
153	32	Osaka Kun'ei Joshi Tanki Daigaku Kenkyu Kiyo	2	0.03
154	32		2	0.03
155	32	Organosilicon chem IV(Lect. Poster contrib. Muechner Silicontage 4th 1998)	2	0.03
156	32	Organic Letters	2	0.03
157	32	Wuhan Gongye Daxue Xuebao	2	0.03
158	32	Toxicol Environ. Chem.	2	0.03
159		Mol. Cryst. Liq. Cryst. Sci Technol. Sect	2	0.03
160	32	Met. Finish	2	0.03
161	32	Insight (Northanipton, U.K)	2	0.03
162	32	Neftekhimiya	2	0.03
163	32	New Journal of Chemistry	2	0.03
164	32	Nihon Reoroji Gokkaishi	2	0.03
165	32	Nanjing Ligong Daxue Xuebao	2	0.03
166	32	Nippon Kagaku Kaishi	2	0.03
167	32	NASA Conference Publications	2	0.03
168	32	Huanjing Baohu (Beijing)	2	0.03
169	32	Huagong Keji	2	0.03
170	32	Tekstil	2	0.03
171	32	Textile Research Journal	2	0.03
172	32	Kemikaru Enjiniyringu	2	0.03
173	32	Shikizai Kyokaishi	2	0.03

174	32	S.African ZA	2	0.03
175	32	Spec. Chemistry	2	0.03
176	32	Kabushiki Kaisha	2	0.03
177	32	Senshoku Kogyo	2	0.03
178	32	Qingdao Daxue Xuebao, Gongcheng Jishuban	2	0.03

Table 1.1

SHOWING RANGE OF FREQUENCY

S.No.	Frequency Range	No. of Periodicals	No. of items	Percentage	Cumulative Percentage
1	1000	1	1282	25.26	25.26
2	99-999	6	2323	45.77	71.03
3	30-98	12	537	10.57	81.60
4	10-29	16	202	3.98	85.58
5	3-9	74	345	6.79	92.37
6	1-2	316	386	7.60	99.97
Total		**425**	**5075**	**99.97**	

2. Country wise Distribution:

It is a known fact that certain countries give more research output in a particular subject than others. This information is very much useful not only for the information managers in finalizing the subscription list of periodicals but also for the research scholars as they tend to know the countries that are leaders in the field.

Table - 2 contains a list of 49 countries producing research material on Surfactants and Detergents. These countries have been ranked on the basis of frequency of occurrence of items. It was observed that 25.57% articles were published from Japan only. This is followed by Switzerland and USA which produce 19.66% and 9.77% research items respectively.

The analysis not only shows the most potent countries of research on Surfactants and Detergents but also indicates the wide coverage of Chemical Abstracts, as the publication from 49 countries of the world have been listed.

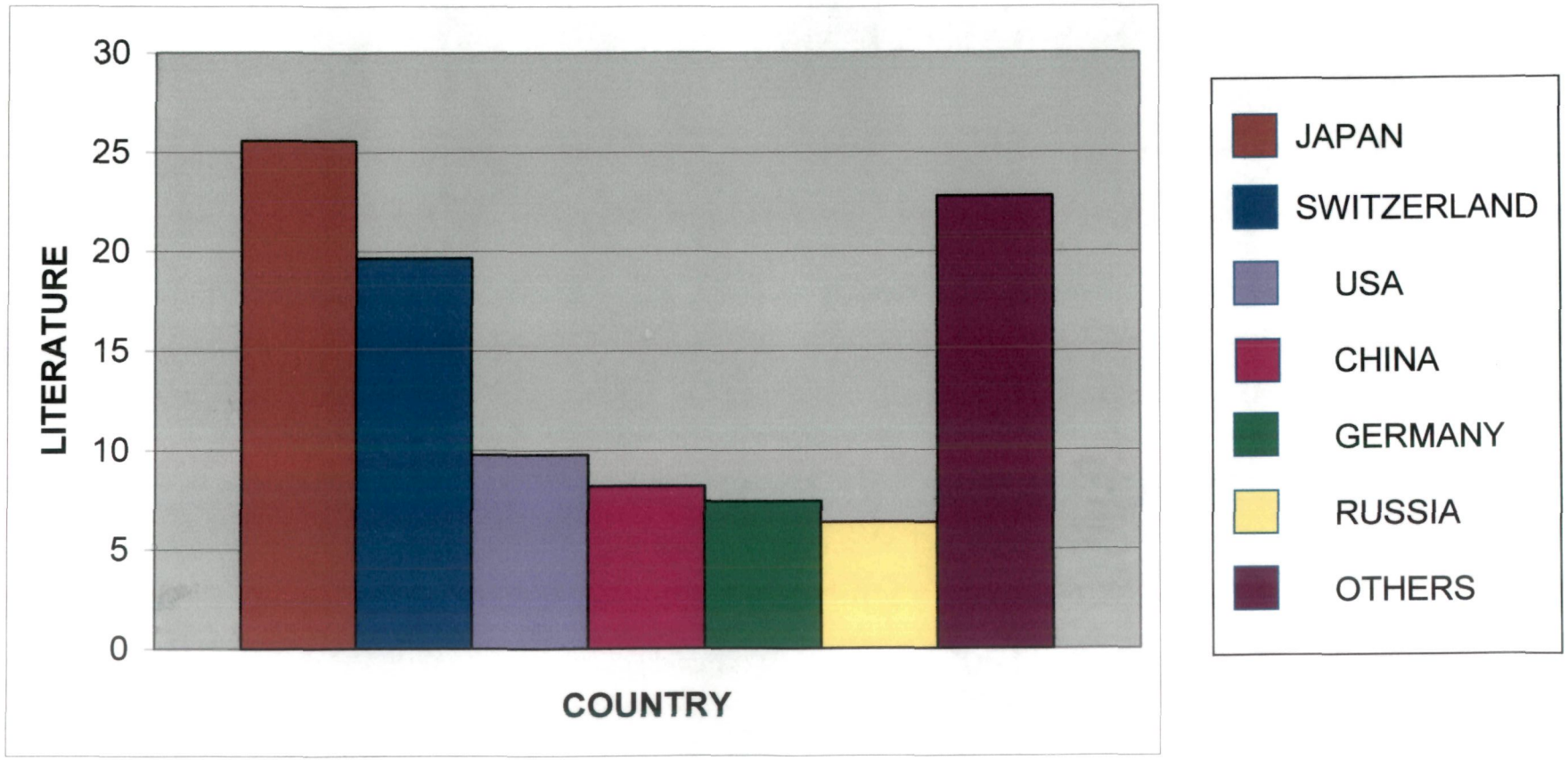
Table – 2

COUNTRY WISE DISTRIBUTION

S.No.	Rank	Name of Country	Frequency	Percentage
1	1	Japan	1298	25.57
2	2	Switzerland	998	19.66
3	3	USA	496	09.77
4	4	China	416	08.19
5	5	Germany	376	07.40
6	6	Russia	322	06.34
7	7	Korea	184	03.62
8	8	Nether land	176	03.46
9	9	Nigeria	146	02.87
10	10	U.K.	137	02.69
11	11	France	87	01.71
12	12	Romania	78	01.53
13	13	Spain	50	00.98
14	14	Roland	46	00.90
15	15	Canada	40	00.78
16	16	*Portuguese*	37	00.72
17	17	Italy	33	00.65
18	18	Hungry	30	00.59
19	19	Czech Republic	20	00.39
20	20	Denmark	15	00.29
21	21	Australia	10	00.19
22	22	India	8	00.15
23	23	Brazil	6	00.11
24	23	Israel	6	00.11
25	23	Serbia	6	00.11
26	24	Lithuania	5	00.09
27	24	Slovakia	5	00.09
28	25	Sweden	4	00.07
29	25	S. Afirica	4	00.07
30	26	Belgium	3	00.05
31	26	Ukraine	3	00.05
32	26	Austria	3	00.05
33	26	Nile	3	00.05
34	27	Crotia	2	00.03
35	27	Newzealand	2	00.03

36	27	Bulgeria	2	00.03
37	27	Finland	2	00.03
38	27	Cuba	2	00.03
39	27	Syria	2	00.03
40	27	Taiwan	2	00.03
41	27	Indonesia	2	00.03
42	28	Thailand	1	00.01
43	28	Algeria	1	00.01
44	28	Turkey	1	00.01
45	28	Greece	1	00.01
46	28	Kenya	1	00.01
47	28	Slovenia	1	00.01
48	28	Iran	1	00.01
49	28	Sudan	1	00.01
Total			**5075**	**99.73**

DIAGRAM 1 – REPRESENTING COUNTRY WISE LITERARY OUTPUT



3. Year Wise Distribution

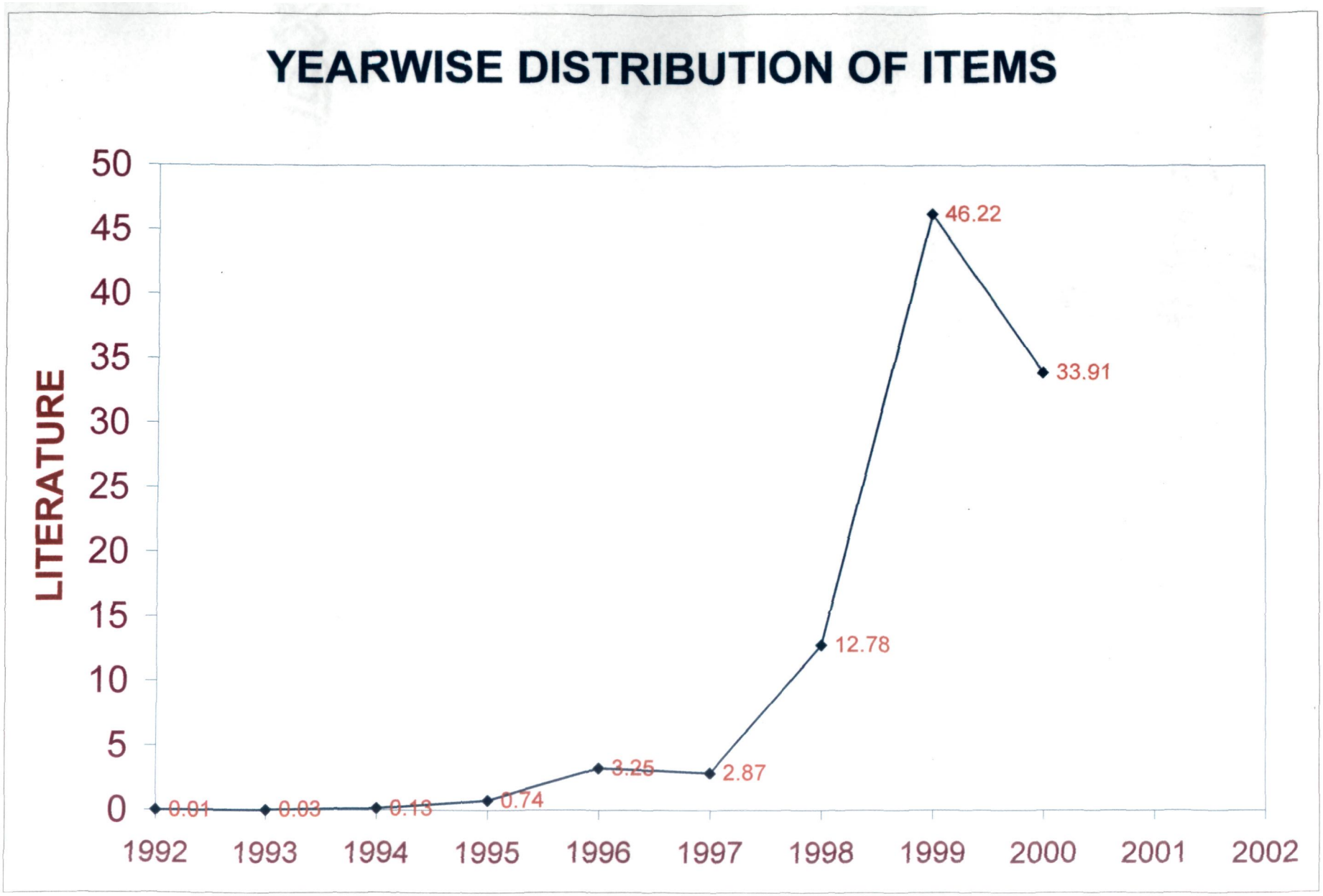
Currency of information is an important factor for any good abstracting service. The main objective of the chronological study is to find out current information published by Chemical Abstract. This study is too much useful in knowing the currency of information and also in knowing the most productive year of items ranked. Through this study, we know that how many articles were published in which year.

Table –3 Shows the chronological scattering of all references. It gives the number of items published in the volumes of 1999-2000 in Chemical Abstract in different years. It is to be observed that the frequency of occurrence of items in the volume 1999 was the highest i.e. 1730 for the same year and that of 2000 the frequency of occurrence was 1721, which was again the highest for that year. However, the total percentage of the frequency of occurrence of items in both volumes of Chemical Abstract was the highest i.e., 46.22% in 1999. This is followed by 2000 and 1998 with a total percentage of frequency of occurrence as 33.91% and 12.78% respectively.

For the year 1992, 1993, 1994, 1995, 1996 and 1997 the total percentage of frequency of occurrence is 0.01,0.03, 0.13, 0.74, 3.25 and 2.87 respectively.

TABLE – 3
YEAR WISE DISTRIBUTION OF ITEMS

S. No.	Period of Origin	Frequency of occurrence of item in		Total frequency of occurrence	Percentage Frequency of occurrence	Cumulative Percentage Frequency
		Volume 1999	Volume 2000			
1	1992	0	1	1	0.01	0.01
2	1993	1	1	2	0.03	0.04
3	1994	1	6	7	0.13	0.17
4	1995	0	38	38	0.74	0.91
5	1996	84	81	165	3.25	4.16
6	1997	34	112	146	2.87	7.03
7	1998	518	131	649	12.78	19.81
8	1999	1730	616	2346	46.22	66.03
9	2000	0	1721	1721	33.91	99.94
	Total	2368	2707	5075	99.94	


YEARWISE DISTRIBUTION OF ITEMS
LITERATURE
50
45
40
35
30
25
20
15
10
5
0
0.01
0.03
0.13
0.74
3.25
2.87
12.78
46.22
33.91
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002

4. Language Wise Distribution

The main objective of this type of study is to find out the most dominant language or languages in which the literature on the subject 'Surfactants and Detergents' is being produced. Language plays a significant role in the exchange of scientific information. Information about the most dominant language is very much useful for the librarians in the acquisition of periodicals and provision of translation services to the user.

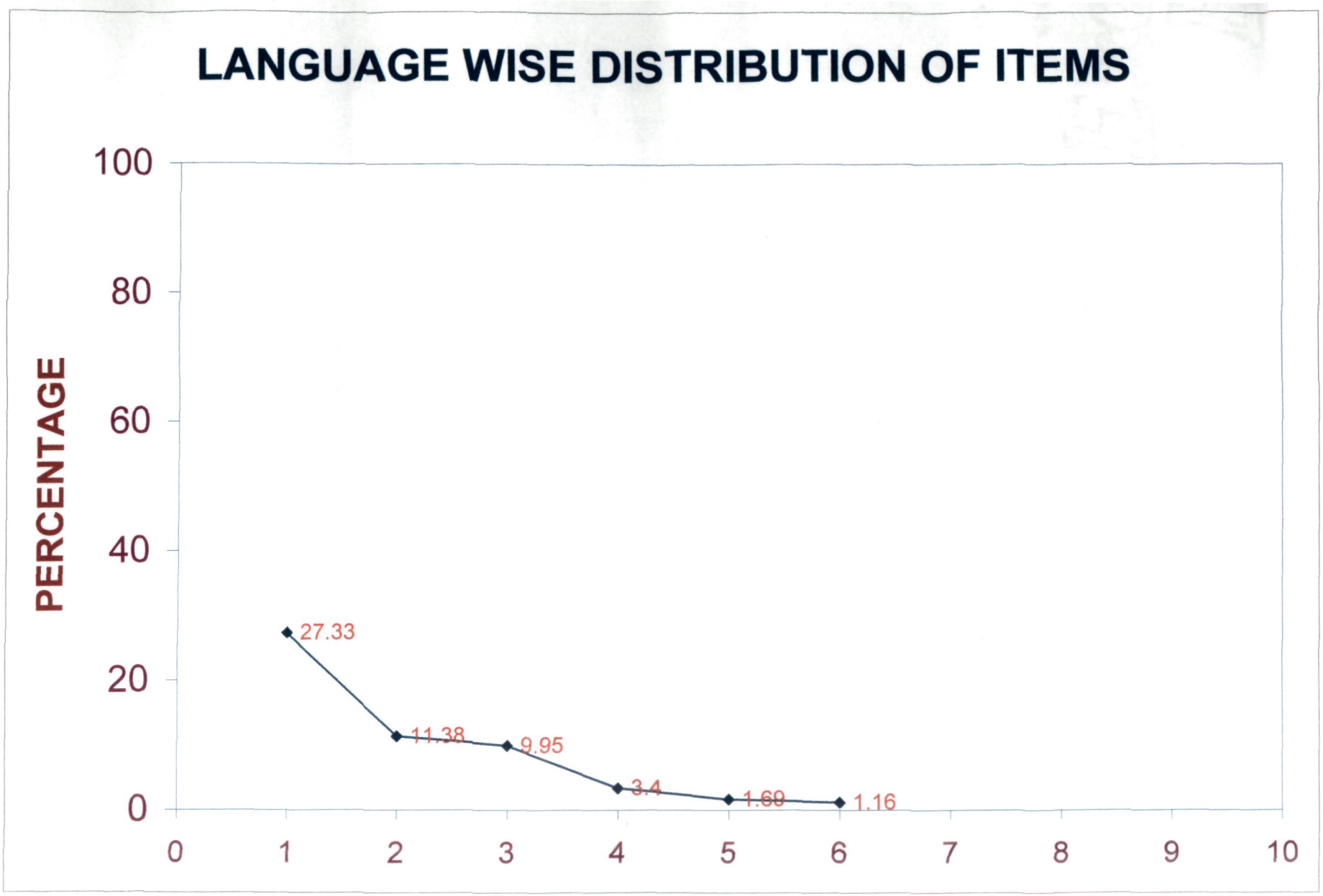
Table 4. Shows that the total number of items (5075) was published in 21 different languages. Out of which English was found to be the most dominant language, as 2164 items constituting 42.64% were reported to be published in that language. The second position is occupied by Japanese Literature, in which 1387 items constituting 27.33% were reported in two volumes of Chemical Abstract. The third, fourth and fifth positions were occupied by, Chinese (11.38%), German (9.95%) and Korean (3.40%) respectively. About 5.16% of the total literature on 'Surfactants and Detergent' is being published in other languages.

Thus, the most dominant language of Scientific Communication on Surfactants and Detergents is found to be English, followed by Japanese, Chinese, German and Korean.

TABLE – 4

LANGUAGE WISE DISTRIBUTION

S.No.	Rank	Name of the language	Frequency occurrence	Frequency %	Cumulative Frequency %
1	1	English	2164	42.64	42.64
2	2	Japanese	1387	27.33	69.97
3	3	Chinese	578	11.38	81.35
4	4	German	505	9.95	91.30
5	5	Korean	173	3.40	94.70
6	6	Russian	86	1.69	96.39
7	7	French	59	1.16	97.55
8	8	Romaine	40	0.78	98.33
9	9	Spanish	24	0.47	98.80
10	10	Polish	23	0.45	99.25
11	11	Portuguese	10	0.19	99.44
12	12	Italian	9	0.17	99.61
13	13	Hungry	6	0.11	99.72
14	14	Croat	3	0.05	99.77
15	15	Czechoslovakian	1	0.03	99.80
16	16	Denmark	1	0.01	99.81
17	16	Lithuanian	1	0.01	99.82
18	16	Ukrainese	1	0.01	99.83
19	16	Slovakian	1	0.01	99.84
20	16	Swedish	1	0.01	99.85
	16	Serbian	1	0.01	99.86
		Total	5075	99.86	


LANGUAGE WISE DISTRIBUTION OF ITEMS
PERCENTAGE
100
80
60
40
20
0
0
1
2
3
4
5
6
7
8
9
10
27.33
11.38
9.95
3.4
1.69
1.16

5.Subject Wise Distribution

Usually, the information on a given subject is published in the journals belonging to the same subject. But sometimes some of the vital information has been found in some related discipline of the subject. This phenomenon is called scattering. The present analysis has been done to know the scattering of literature of Surfactants and Detergents in other subject fields. I have consulted 'Ulrich International Periodicals Directory, to determine the subject field of periodicals. Out of a total of 405 titles, 45 titles constituting 50 items could not be traced in the directory and therefore, have been put under the category unknown. Likewise, the subject of patent could not be assigned as they were not to be found in Ulrich International Periodicals Directory. Any other method to assign the subject of patents, would have led to inconsistency.

It is observed from Table-5 that all the collected items belong to different subject areas, which have been ranked from 1to 18 on the basis of frequency of occurrence of articles. The analysis shows that 12.8% of the literature belongs to Physical Chemistry, 3.44% belongs to Analytical Chemistry, 2.36% belongs to Organic Chemistry, 2% belongs to Chemistry and 1.37% belongs to Chemical Engineering. The frequency of occurrence of items in other subjects is less then 1%.

However, even such a negligible percentage of literature published in different subject fields constitutes a significant amount of literature that might be useful for 'Surfactants and Detergents' specialists and scholars.

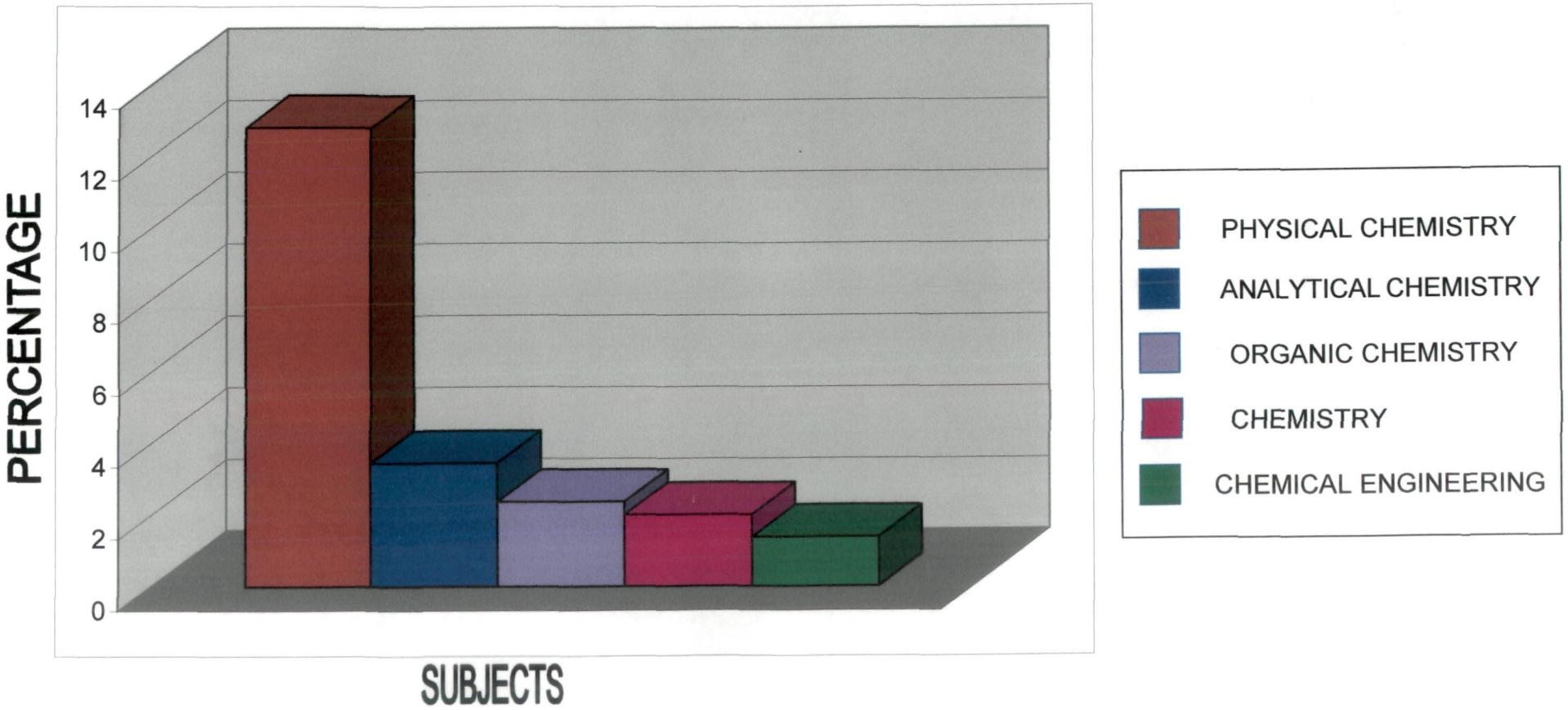
Table – 5

SUBJECT WISE DISTRIBUTION OF ITEMS

S.No.	Rank	Subject Area	Frequency Occurrence	% Frequency	Cumulative Frequency
1	1	Physical Chemistry	650	12.80	12.80
2	2	Analytical Chemistry	175	3.44	16.24
3	3	Organic Chemistry	120	2.36	18.60
4	4	Chemistry	102	2.00	20.60
5	5	Chemical Engineering	70	1.37	21.97
6	6	Environmental Studies	17	0.33	22.30
7	7	Physics	15	0.29	22.59
8	8	Textile Industries and Fabrics	14	0.27	22.86
9	9	Electro Chemistry	13	0.25	23.11
10	10	Biotechnology	12	0.23	23.34
11	11	Biological Chemistry	11	0.21	23.55
12	12	Inorganic Chemistry	8	0.15	23.70
13	12	Energy	8	0.15	23.85
14	13	Metallurgy	6	0.11	23.96
15	13	Sciences – Comprehensive work	6	0.11	24.07
16	14	Crystallography	5	0.09	24.16
17	15	Petroleum and Gas	4	0.07	24.23

18	16	Paper and Pulp	3	0.05	24.28
19	16	Paints and Protective Coating	3	0.05	24.33
20	17	Food and Food Industries	2	0.03	24.36
21	17	Perfumes and Cosmetics	2	0.03	24.39
22	17	Building and Construction	2	0.03	24.42
23	17	Cleaning and Dyeing	2	0.03	24.45
24	18	Earth Sciences	1	0.01	24.46
25		Unknown	50	0.98	25.44
26		Patents	3774	74	99.37
Total			**5075**	**99.37**	

DIAGRAM 4 – REPRESENTING SUBJECT WISE DISTRIBUTION OF ITEMS



6. Form Wise Distribution

Information is available in a variety of forms namely periodicals, conference proceedings, research reports, letters, bulletins, patents etc. The main objective of this study is to find out most used form of source material. It will help the information scientists and their users to know the most dominant forms of documents in which information is being produced on the subject.

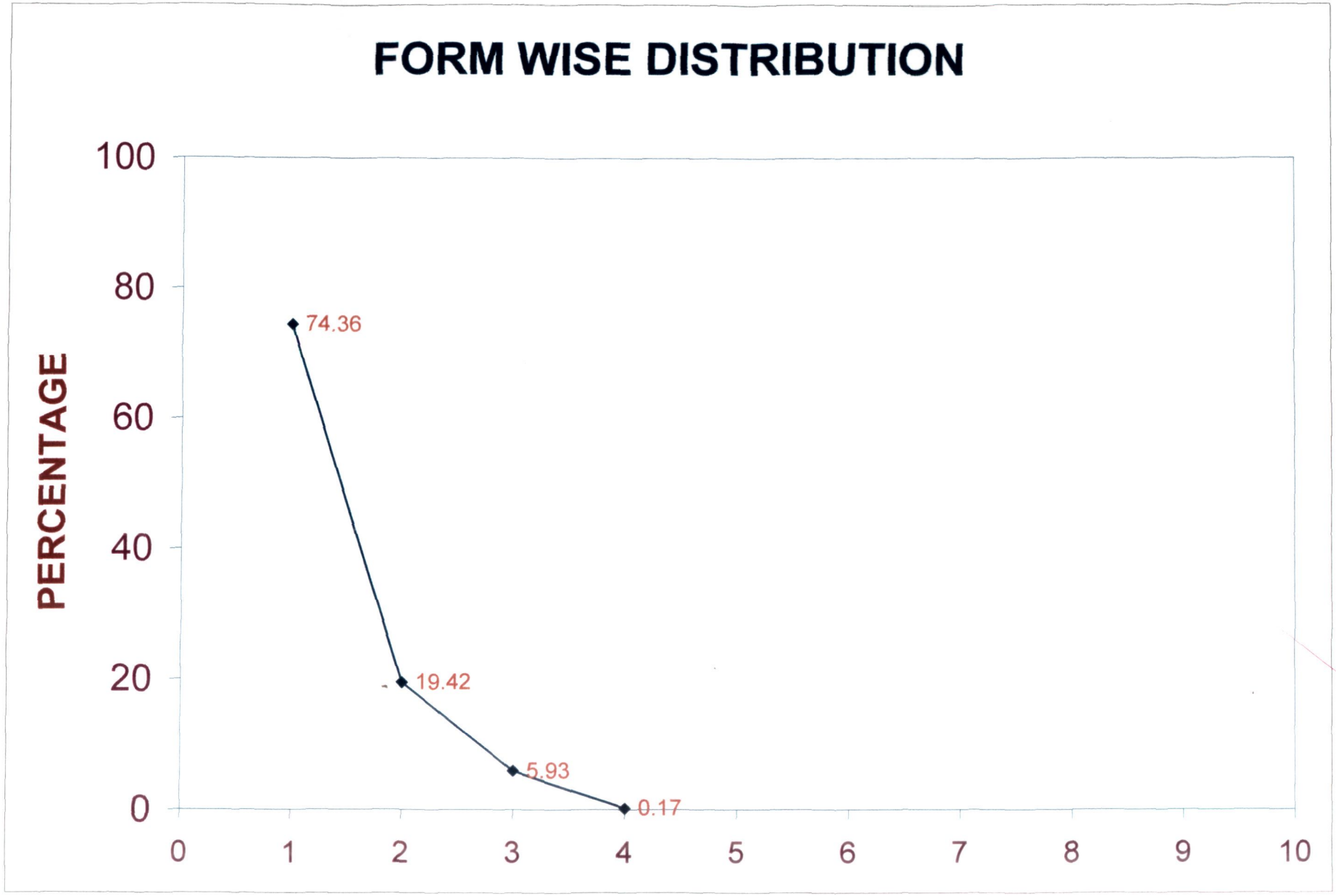
Table - 6 gives the form wise distribution of items. It was found out that patents are the most dominant form in which scientific information is communicated in the field of Surfactants and Detergents. It is obvious from the fact that 74.36% literature on the subject appeared in form of patents. Articles and Reviews constitutes 19.42% and 5.93% of the total, while the other form like conference proceedings, Books and Reports constitute less than 1%.

This analysis may help the information scientist to decide as to which forms of documents he has to procure in the library to meet the information requirements of the researchers in the field of 'Surfactants and Detergents'.

TABLE – 6

FORM WISE DISTRIBUTION

S.No.	Rank	Name Of The Form	Frequency Occurrence	Frequency %	Cumulative Frequency
01	1	Patent	3774	74.36	74.36
02	2	Article	986	19.42	93.78
03	3	Review	301	5.93	99.71
04	4	Proceeding	09	0.17	99.88
05	5	Book	03	0.05	99.93
06	6	Report	02	0.03	99.96
		Total	5075	99.96	


FORM WISE DISTRIBUTION
PERCENTAGE
100
80
60
40
20
0
74.36
19.42
5.93
0.17
0
1
2
3
4
5
6
7
8
9
10

7. Ranking of Authors

There are certain eminent personalities in every subject field who achieve recognition through their research and writings. These personalities form the backbone in their own subjects. The main objective of this study is to find out authors whose contributions are significant in the field of Surfactants and Detergents. For this purpose, a ranking list of eminent authors has been given in Table - 7, in the order of their frequency of occurrence. Analysis shows that 730 items (14.38%) were contributed single author, 1465 items (28.86%) by two authors and 2880 (56.74%) by more than two authors. Therefore, we can say that trend of research in the field of Surfactant and Detergents in joint efforts involved to complete a research project. It may be due to the complexity and inter disciplinary nature of research topics. The first four eminent authors in the field are: Lietzmann, Andreas (30 items); Takano, Katsuyuki (22 items); Ogura, Nobuyuki (22 items); Horie, Hiromichi (21 itmes).

The present ranking list may help in knowing the latest significant contributors in the field of Surfactants and Detergents. Such authors may be given due place in the bibliographical services provided in the Subject.

TABLE – 7

RANKING OF AUTHORS

S.NO.	Rank	Name of the Authors	Frequency
1.	1	LIETZMANN, ANDREAS	30
2.	2	TAKANO, KATSUYUKI	22
3.	2	OGURA, NOBUYUKI	22
4.	3	HORIE, HIROMICHI	21
5.	4	OKANO, TOMOMICHI	18
6.	5	FOLEY, PETER ROBERT	16
7.	6	TAKAHASHI,MASATOSHI	14
8.	6	O'LENICK, ANTHONY J	14
9.	6	LEE, YU-SOON	14
10.	6	TANAKA, ATSUSHI	14
11.	7	HOLDERBAUM, THOMAS	13
12.	7	MORITA, HIROSHI	13
13.	7	TAGATA, SHUJI	13
14.	8	YAMAZAKI, YOSHIHIRO	12
15.	9	BETTIOL, JEAN-LUCPHILIPPE	11
16.	9	DURBURT, PATRICK	11
17.	9	FLORESCU, STELA	11
18.	9	SCHMID, KARL-HEINZ	11
19.	9	YOKOI, KENJI	11
20.	10	ARTIGA GONZALES, RENE-ANDRES	10
21.	10	SHOWELL, MICHAEL STANFORD	10
22.	10	THOMAS, BARBARA	10
23.	11	ANON	9
24.	11	DEL DUCA, VALERIO	9
25.	11	FUJII, YUKIKO	9
26.	11	GORLIN, PHILIP	9
27.	11	ISHIKAWA, AKIRA	9
28.	12	KANEKO, YOHEI	8
29.	12	SCHEIBEL, JEFFERY JOHN	8
30.	12	VINSON, PHILLIP KYLE	8
31.	12	WAGNER, R	8
32.	12	YAMAGUCHI, SHIGERU	8
33.	13	ANBAY, ERIC	7
34.	13	BERNDT, WOLF-DIETER R	7
35.	13	CHA, KYUNG-ON	7
36.	13	CHEUNG, TAKWAI	7
37.	13	CAO, HOAI-CHAI	7
38.	13	DRAPIER, JULIEN	7
39.	13	GROSS, STEPHEN F	7
40.	13	HENSEN, HERMANN	7
41.	13	KOTT, KEVIN LEE	7
42.	13	KONDO, JUNJI	7
43.	13	LEE, CHI-WOO	7
44.	13	MERTENS, BAUDOUIN	7

45.	13	TODINI, ORESTE	7
46.	13	USHIO, NORIAKI	7
47.	13	VLASBLOM, JACK T	7
48.	13	WOO, RICKY AH-MAN	7
49.	14	BLOCK, CHRISTIAN	6
50.	14	BRIOTORE, ANDREA	6
51.	14	BARNABAS, MARY VIJAYARANI	6
52.	14	CUI, ZHENGGANG	6
53.	14	CARDOLA, SERGIO	6
54.	14	CAO, YA	6
55.	14	DETERING, JURGEN	6
56.	14	DE BUZZACCARINI, FRANCESCO	6
57.	14	EMERY, WILLIAM DEREK	6
58.	14	FUJIMOTO, ETSUO	6
59.	14	GAMBOGI, JOAN E	6
60.	14	GENIX, LIONEL BERNARD MICHEL	6
61.	14	HARTSHORN, RICHARD TIMOTHY	6
62.	14	HAERER, JUERGEN	6
63.	14	INAOKA, TORU	6
64.	14	ISHIKAWA, SATOSHI	6
65.	14	JOSA, JAUME	6
66.	14	KOTTWITZ, BEATRIX	6
67.	14	KWAK, SANG-WOON	6
68.	14	KAHRE JOERG	6
69.	14	KAWAGUCHI, KOJI	6
70.	14	KASTURI, CHANDRIKA	6
71.	14	LITTING, JANET SUE	6
72.	14	LI, GANZUO	6
73.	14	MASUI, HUROYUKI	6
74.	14	MOELLER, THOMAS	6
75.	14	NISHINO, TAKASHI	6
76.	14	YAMAGUCHI, YUKIYOSHI	6
77.	15	ABE, MASAHIKO	5
78.	15	AIHARA, NOBORU	5
79.	15	BLASEY, GERHARD	5
80.	15	BLUM, HELMUT	5
81.	15	BOECKER, MONIKA	5
82.	15	BOUTIQUE, JEAN-POL	5
83.	15	CRUTCHER, TERRY	5
84.	15	DICAPUA, GLORIA	5
85.	15	FONSNY, PIERRE	5
86.	15	FENDER, MICHAEL	5
87.	15	GHOSH, CHANCHAL KUMAR MANOHAR	5
88.	15	GRUNING, BURGHARD	5
89.	15	HRECZUCH, WIESLAW	5

90.	15	HERBOTS, IVAN MAURICE ALFONS JAN	5
91.	15	IIHARA, TADASHI	5
92.	15	INOUE, TAKUMI	5
93.	15	KRUSE, HANS-FRIEDRICH	5
94.	15	KANAYAMA, HIROYUKI	5
95.	15	KATO, TORU	5
96.	15	KISHI, MINORU	5
97.	15	KIMURA, HIROSHI	5
98.	15	KIKUKAWA, MASAZUMI	5
99.	15	KVIETOK, FRANK ANDREZ	5
100.	15	LU, ROBERT ZHONG	5
101.	15	MERTENS, BAUDOUIN	5
102.	15	NESTLER, BERND	5
103.	15	PARK, SEUNG-KYU	5
104.	15	SAITO, MAKOTO	5
105.	15	SCHMIEDEL, PETER	5
106.	15	SCHEPER, WILLIAM MICHAEL	5
107.	15	SATSUKI, TERUHISA	5
108.	15	SHIGEMATSU, KUMYOSHI	5
109.	15	TALLEY, CHARLES BULLICK	5
110.	15	TRINH, TOAN	5
111.	15	TSUBONE, KAZUYUKI	5
112.	15	UMEMOTO, MASAO	5
113.	16	ANGELL, ADRIAN JOHN WAYNFORTH	4
114.	16	BISSEL, PHILIPPE	4
115.	16	BLACK, ROBERT H	4
116.	16	BOLZONI, GIUSEPPE	4
117.	16	BOSKAMP, JELLES VINCENT	4
118.	16	BEHLER, ANSGAR	4
119.	16	BALKAN, MARIETA	4
120.	16	BAKSHI, MANDEEP SINGH	4
121.	16	BAECK, ANDRE CESAR	4
122.	16	BAILLEY, GERARD MARCEL	4
123.	16	CHO, KI-HUN	4
124.	16	CHAMBERS, JOHN GEORGE	4
125.	16	CAPECI, SCOTT WILLIAM	4
126.	16	CARR, CHARLES D	4
127.	16	CALA, FRANCIS R.	4
128.	16	DETTINGER, JOHANNES	4
129.	16	D' AMBROGIO, ROBERT	4
130.	16	EWBANK, ERIC	4
131.	16	FANG, YUN	4
132.	16	FUKUSHIMA, YUKIKO	4
133.	16	FUJITA, KAORI	4
134.	16	FUJIWARA, MITSUKO	4

135.	16	FOSTER, ALVIE L	4
136.	16	GUO, YONGJUN	4
137.	16	GAO, LIN	4
138.	16	GLENN, ROBERT WAYNE, JR	4
139.	16	GRIPPAUDO, GABRIELLA	4
140.	16	GEÑOVA, CALOGERO	4
141.	16	GIBBS, ANTHONY MARSTON	4
142.	16	GIRGIS, ADEL Y	4
143.	16	GOOSELINK, EUGENE PAUL	4
144.	16	HEINZMAN, STEPHEN WAYNE	4
145.	16	HAZENKAMP, MENNO F	4
146.	16	HARA, ATSUSHI	4
147.	16	HILL, RONALD M	4
148.	16	JUNG, KOOK-INN	4
149.	16	KACHER, MARK LESLIE	4
150.	16	KARSA, DAVID R	4
151.	16	KIM, JIN-WOO	4
152.	16	KOSTER, RITA	4
153.	16	KITSCHKEL, DITMAR	4
154.	16	KIS, MARIA	4
155.	16	KIM, TAE-KON	4
156.	16	KATSUDA, RINKO	4
157.	16	KANEKO, DAISUKE	4
158.	16	KOBOSHI, HITOSHI	4
159.	16	LU, XIUJUAN	4
160.	16	LEE, CHI-WOO	4
161.	16	MATSUO, SHIGERI	4
162.	16	MIYAMOTO, HISASHI	4
163.	16	MOCHIZUKI, YUJI	4
164.	16	MORITA, AKITOMO	4
165.	16	MIYASAKI, YOSHITAKA	4
166.	16	NIKAIDO, MASARU	4
167.	16	NISHIMURA, EIJI	4
168.	16	OSSET, HERNANDEZ MIGUEL	4
169.	16	POLICELLO, GEORGE A	4
170.	16	POETH, JOERG	4
171.	16	PANANDIKER, RAJAN KESHAV	4
172.	16	PARRY, DAINE	4
173.	16	PAATZ, KATHLEEN	4
174.	16	PONANDIKER, RAJAN	4
175.	16	RICCI, PATRIZIO	4
176.	16	RODRIGUES KLIEIN A	4
177.	16	RACHERLA, UDAY SHANKER	4
178.	16	RAI, SAROJ	4
179.	16	SCALLA, STEFANO	4

180.	16	SHOUJI, KENZO	4
181.	16	STRINGER, ORUM D	4
182.	16	TAKAHASHI, SHINOBU	4
183.	16	TAMURA, MASARU	4
184.	16	TRAJANO, TRACE WENDELL DE GUZMAN	4
185.	16	TONG, ZHONGLIANG	4
186.	16	USHIYAMA, HIROTOSHI	4
187.	16	VEGA, JOSE LUIS	4
188.	16	WANG, MAOYI	4
189.	16	WILLMAN, KENNETH WILLIAM	4
190.	16	YAMAMOTO, GORO	4
191.	16	YIN, BAO-LIN	4
192.	16	YAMADA, TOSHIROU	4
193.	16	ZOCCHI, GERMAINE	4
194.	17	APPEL, PETER WILLEM	3
195.	17	APPEL, ADRIANUS	3
196.	17	ASGHASIAN, BAHRAM	3
197.	17	ASSMANN, GEORG	3
198.	17	ABE, KOJI	3
199.	17	AMAN, SHUNJI	3
200.	17	AKKENMANS, JOHANNES	3
201.	17	ABE, M	3
202.	17	ANDERSON, DENISE	3
203.	17	AHMAD, FAHIMUDDIN	3
204.	17	AKUTSU, TAKAHIRO	3
205.	17	BHATIA, ATUL	3
206.	17	BLANVALET, CLAUDE	3
207.	17	BINKS, BERNARD PAUL	3
208.	17	BIJSTERBOSCH, HENRI DERK	3
209.	17	BEVILACQUA, PHILIP, JR.	3
210.	17	BURNS, ROBERT L	3
211.	17	BODET, JEAN-FRANCOIS	3
212.	17	BORREGO, ENCARNACION	3
213.	17	BRONZE, GUY	3
214.	17	BAKER, IRENE JA	3
215.	17	BAUER, HARALD	3
216.	17	BACHMANN, FRANK	3
217.	17	CSERHATI, TIBOR	3
218.	17	CONNOR, DANIEL STEDMAN	3
219.	17	CHEN, YOUHONG	3
220.	17	CHANG, ZHI-CHENG	3
221.	17	CHAPMAN, BENJAMIN EDGAR	3
222.	17	CARRION FITE, FRANCISCO JAVIER	3
223.	17	DAHANAYAKE, MANILAL S	3
224.	17	DHANUKA, VINOD KUMAR RAMNIRANJAN	3

225.	17	DE GUZMAN, TRAJANO	3
226.	17	DEGROOT, RICHARD J	3
227.	17	ENDLEIN, EDGAR	3
228.	17	ELI, WUMANJIANG	3
229.	17	FAROOQ, AMJAD	3
230.	17	FUKUDA, MORINOBU	3
231.	17	FAN, YUN	3
232.	17	FRASER, STUART BERNARD	3
233.	17	FRYKMAN, HANS B	3
234.	17	GASSENMEIER, THOMAS	3
235.	17	GERLACH, NEIL JAMES	3
236.	17	GORDON, NEIL JAMES	3
237.	17	GIESEN, BRIGITTE	3
238.	17	HAMADA, YOSHIMI	3
239.	17	HEES, VDO	3
240.	17	HAMADA, YOSHIMI	3
241.	17	HAUTHAL, HERMANN G	3
242.	17	HONMA, MASATOSHI	3
243.	17	HORTEL THOMAS CHARLES	3
244.	17	ISOBU, YOSHIKO	3
245.	17	IWABUCH, HIROYUKI	3
246.	17	IL,IN, B. A	3
247.	17	IWAO, SHIJI	3
248.	17	JIN, YAN	3
249.	17	JIMENEZ CARRILLO, LIDIA	3
250.	17	JONKE, HERMANN	3
251.	17	KOO, JEKWON	3
252.	17	KOIKE, AKIRA	3
253.	17	KANDASAMY, MANIVANNAN	3
254.	17	KAWANABE, TAKESHI	3
255.	17	KOTTWITZ, BEATRIX	3
256.	17	KISHI, MINORU	3
257.	17	KURODA, TOSHIHARU	3
258.	17	LEWIS, RONALD G	3
259.	17	LAZAROWITZ, VIRGINIA	3
260.	17	LARSON, BERND	3
261.	17	LEE, JONG KYUN	3
262.	17	LITTAU, CHERYL ANN	3
263.	17	LITIEULE, SYLVIE	3
264.	17	LABEQUE, REGINE	3
265.	17	LAGARDEN, MARTIN	3
266.	17	LENTSCH, STEVEN E	3
267.	17	LENOIR, PIERRE M	3
268.	17	LI, DEXIN	3
269.	17	MARS, HEIKO	3

270.	17	MOBAIER, MARCIA REGINA DOMINGUES	3
271.	17	MIZUTANI, MASUMI	3
272.	17	MISAJON, ISAURO MANUEL E	3
273.	17	MIYAMAE, YOSHITAKA	3
274.	17	MONDIN, MYRIAM	3
275.	17	MATSUMOTO, KIYOSHI	3
276.	17	MASSCHELEIN, AXEL	3
277.	17	MASUI, HIROYUKI	3
278.	17	MACKAWA, KAZUO	3
279.	17	MURAYAMA, TOMOHIRO	3
280.	17	MURPHY, DENNIS STEPHEN	3
281.	17	MONDIN, MYRIAM	3
282.	17	MENDOZA, CRUZ	3
283.	17	MENGER, FREDRIC M	3
284.	17	MEINE, GEORG	3
285.	17	NISHIMURA, ISAO	3
286.	17	NIELSEN, C	3
287.	17	NAKAMURA, TAKASHI	3
288.	17	OHTAGURO, TAKAHIRO	3
289.	17	OZAKO, KAZUYOSHI	3
290.	17	ONUKI, TAKESHI	3
291.	17	PARK, BUM-HO	3
292.	17	PRESSNER, DIETMAR	3
293.	17	QUEBEDEAUX, DEBORAH A	3
294.	17	RACOTA, MARIA	3
295.	17	ROBERTS, D.W	3
296.	17	RAMANAN, GANAPATHY VENKATA	3
297.	17	RACHSE, WILFRIED	3
298.	17	SHINDO, HIROYUKI	3
299.	17	SCEPANSKI, WILLIAM H	3
300.	17	SASAKI, HISAYA	3
301.	17	SHUBKIN, RONALD R	3
302.	17	SAKAKI, TAKAKO	3
303.	17	SMETS, JOHAN	3
304.	17	TAHA, RIAD AHMAD	3
305.	17	TERASAKI, HIROYUKI	3
306.	17	TANO, AKIO	3
307.	17	TAKIMOTO, HITOSHI	3
308.	17	TAKAHASHI, KENICHI	3
309.	17	TAMAI, YOSHIKAZU	3
310.	17	THENAPPAN, ALAGAPPAN	3
311.	17	TANIMOTO, HITOSHI	3
312.	17	TCHEOU, ERIC	3
313.	17	UPHUES, GUENTER	3
314.	17	UNO, MITSURU	3

315.	17	WANG, CUNYAN	3
316.	17	WAESCHENBACH, GUIDO	3
317.	17	WANG, QIN	3
318.	17	WANG, YONGLIANG	3
319.	17	YOSHII, TORU	3
320.	17	YIANAKOPOULOS, GEORGES	3
321.	17	YEAZELL, BRUCE ALBERT	3
322.	17	ZHAO, JIANXI	3
323.	18	ARNAU, JOSE	2
324.	18	ANSAI, RYWICHI	2
325.	18	ABBOT, NICHOLAS L	2
326.	18	ANDO, TOMOYA	2
327.	18	ANDO, RYOTA	2
328.	18	ARANDA, R	2
329.	18	ARVANITIDOU, EVANGELIA	2
330.	18	ACHANTA, SRINIVAS	2
331.	18	ABBAS, SYED HUSSAIN	2
332.	18	AYORINDE, FO	2
333.	18	ABRAMZON, AA	2
334.	18	ARAKI, YOSHITAKE	2
335.	18	ARONSON, MICHAEL PAUL	2
336.	18	BIRD, NIGEL PETER	2
337.	18	BERNDT, DIETER R	2
338.	18	BLANDIAUSE, GENEVIEVE	2
339.	18	BURNS, MICHAEL EUGENE	2
340.	18	BUSCH, ALFRED	2
341.	18	BOECKER, M	2
342.	18	BOGAERT, PMP	2
343.	18	BOGNOLO, G	2
344.	18	BROUGHAM, PETER RUTHERFORD	2
345.	18	BRAGNLLA, SIEGFRIED	2
346.	18	BRONICH, TATIANA K	2
347.	18	BROOKER, ALAM THOMAS	2
348.	18	BEAVER, PHILLIP R	2
349.	18	BECKER, KLAUS	2
350.	18	BERTLEFT, WERNER	2
351.	18	BACK, INN-SUB	2
352.	18	BAE-LEE, MYONGSUK	2
353.	18	BAKER, KEITH HOMER	2
354.	18	BAZIN, HELEN G	2
355.	18	BARNHORST, JEFFREY A	2
356.	18	BARTOLETTI, MARCELLA	2
357.	18	CHA, SEUNG-HO	2
358.	18	CRUTZENN, ANDRE	2
359.	18	CRUDEN, JOSEPH J	2

360.	18	CALURCICLLO, ANDREW FRANCIS, JR.	2
361.	18	CAUWBERGHS, SERGE GABRIEL	2
362.	18	CHEN, ZHAOWEN	2
363.	18	CHEN, HUA	2
364.	18	CHAN, ALBERT FOON-CHIU	2
365.	18	CHALEZ, MARIA JOSE	2
366.	18	CHOY, CLEMENT K	2
367.	18	CASTEEL, SASCHA	2
368.	18	CAMPESTRINI, SANDRO	2
369.	18	CARRION FITE	2
370.	18	CONVENTS, ANDRE CHRISTIAN	2
371.	18	CASSADY, TIMOTHY	2
372.	18	CALLAGHAN, JIA C	2
373.	18	CABLE, ELIZABETH A	2
374.	18	DANIELS, JUDY	2
375.	18	DAVISTER, MICHELE	2
376.	18	DULGHERU, ALEXANDRA	2
377.	18	DOYEL, KYLE J	2
378.	18	DAWSON, HILTON G	2
379.	18	DEMEYERE,HUGO JEAN MARIE	2
380.	18	DICKLER, LAWRENCE R	2
381.	18	DUCCINI, YVES	2
382.	18	DELROISE, MICHAEL GILBERT-JOSE	2
383.	18	DERECSKEI, FRANCISE	2
384.	18	DUWAL, DEAN LARRY	2
385.	18	DARADICS, LORANT	2
386.	18	DELANEY, SUSAN	2
387.	18	DE MESANTOURNE, REGINE	2
388.	18	DIETZ, THOMAS	2
389.	18	EBIHARA, FUKUJI	2
390.	18	ESKUCHEN, RAINER	2
391.	18	ERILLI, RITA	2
392.	18	ERIKSON, TORD GEORG SWED	2
393.	18	ENDO, KENJI	2
394.	18	FLYNN, RICHARD M	2
395.	18	FRIEDLI, FLOYD	2
396.	18	FENG, YONGLAN	2
397.	18	FALABELLA, ELIZABETH	2
398.	18	FANG, GUOZHEN	2
399.	18	FANG, GUILAN	2
400.	18	FAIRCHILD, E. H	2
401.	18	FAN, XIN	2
402.	18	FAN, JINSHI	2
403.	18	FOLMER, BRITTA M	2
404.	18	FINCH, TIMOTHY DAVID	2

405.	18	FUJII, TOMIKO	2
406.	18	FARREL, TERENCE	2
407.	18	FAN, XUANMIN	2
408.	18	FENNEY, MICHAEL KEITH	2
409.	18	FERLIN, PATRICK	2
410.	18	FEDERHAN, BERND	2
411.	18	FENG, GUANGHUA	2
412.	18	FENG, XUEJUN	2
413.	18	FARNANDEZ, ANA MARIA	2
414.	18	FOX, SANDRA L	2
415.	18	FORSTER,TH.	2
416.	18	FORSCHUNGSZENTURN JUELICH G.M.B.H.	2
417.	18	FONTANA, CINZIA	2
418.	18	FOUNTAIN, L.E	2
419.	18	FOERSTER, THOMAS	2
420.	18	FUKUNAGA, AKIRA	2
421.	18	FUJII TOSHIAKI	2
422.	18	FU, XIAOYAN	2
423.	18	FUKUMURA, KAZUNORI	2
424.	18	FUKUSHIA, NORIKO	2
425.	18	FUJIMOTO, TAKESHI	2
426.	18	FURUKAWA, MASANORI	2
427.	18	FUKUDA, KUNIO	2
428.	18	FUKAZU, HIROSHI	2
429.	18	FUJINO, TETSUYA	2
430.	18	FELIX, BERND.	2
431.	18	FERARI, CONSTATIN	2
432.	18	FILIPOVIC-VINCEKOVIC, N	2
433.	18	FIS, J	2
434.	18	FILIPESCU, LAURENTIU	2
435.	18	FIRKINS, SIMON	2
436.	18	FUKUDOME, SHINICHI	2
437.	18	FURUKAWA, MASAKAZU	2
438.	18	FU, DONG.	2
439.	18	FURLONG, D.NEIL	2
440.	18	NEILFUKAZAWA, YUJI	2
441.	18	FUTTER, KERI	2
442.	18	FLEURY, ETIENNE	2
443.	18	FRIBERG, STIG E	2
444.	18	FRAUCHIGER, LOTTI	2
445.	18	FRENIER, WAYNE W	2
446.	18	GUEDIRA, NOUR-EDDINE	2
447.	18	GUO, RONG	2
448.	18	GALLI, MARCO	2
449.	18	GAO, JUN	2

450.	18	GHOSH, SOUMEN	2
451.	18	GILLETE, SAMUEL MARK	2
452.	18	GRIBOV, B.G.	2
453.	18	GLADKII, F.F	2
454.	18	GAEVOI, E.G	2
455.	18	GAO, FUQI	2
456.	18	GAO, ZHIQING	2
457.	18	GARTE, N	2
458.	18	GAGLIARDI, LUIGI	2
459.	18	GAGLIARDI, LEO	2
460.	18	GAUTHIE, FRANEOR	2
461.	18	GAO, GUANGPING	2
462.	18	GOTO, YOSHIKAZU	2
463.	18	GUAN, PIEGE	2
464.	18	GUO, TINGQIAO	2
465.	18	GUO, JINHUA	2
466.	18	GU, YIPING	2
467.	18	GUITIS, MICHAEL	2
468.	18	GUO, LIN	2
469.	18	GUTMAN, G.M	2
470.	18	GUO, WEI-LING	2
471.	18	GUO, ZHENCHU	2
472.	18	GRIFFITHS, PAULA	2
473.	18	GROOT,ANDREAS THEODORUS JOHANNNES	2
474.	18	GALLI, MARCO	2
475.	18	GIBSON, KEITH	2
476.	18	GILCHRIST, V.A	2
477.	18	GENTILHOMMES, PHILIPPE	2
478.	18	GAO, WANSHAN	2
479.	18	GOEL, SATISH K	2
480.	18	GODFROID, ROBERT ALLEN	2
481.	18	GONCHARUK, I.I	2
482.	18	GOSPENDINOV, D.G	2
483.	18	GONZALEZ, MONTERO	2
484.	18	GOWRISHANKARAN, CHANDRASEKRAM	2
485.	18	GONZALEZ-GAITANO, G	2
486.	18	GOSPODINOV, I.P	2
487.	18	GONZALEZ, X	2
488.	18	GOON, PIYALI	2
489.	18	GOEDHART, MICHAEL	2
490.	18	GAUTHEIR-LAFAYE	2
491.	18	GOLDEN, JERRY	2
492.	18	GOTO, HIDETO	2
493.	18	GHARIBI, H	2

494.	18	GRELL, E	2
495.	18	GLAVAT, O.L	2
496.	18	GUTIERREZ, EDDIE NELSON	2
497.	18	HAILU, LIBEN	2
498.	18	HASEGAWA, AKIRA	2
499.	18	HATTORI, MASASHIGE	2
500.	18	HAGER, C.D	2
501.	18	HA, YOUN-SHIEK	2
502.	18	HAMAMICHI, YO SHIKO.	2
503.	18	HAYASHI, HI EIJI	2
504.	18	HAYASHI, HIROMITSU	2
505.	18	HAGGEBERG, DONNA JEAN	2
506.	18	HARTH, HUBERT	2
507.	18	HILL, K	2
508.	18	HARRIS, MICHAEL	2
509.	18	HASEGAWA, TAKAMICHI	2
510.	18	HALL, ROBIN GIBSON	2
511.	18	HWANG, KYUNG-AH	2
512.	18	HSU, FENG-LUNG GORDEN	2
513.	18	HIMMRICH, JOHANNES	2
514.	18	HENSEN, TIFFANY ALICE	2
515.	18	HENWING, KLAUS	2
516.	18	HELLBERG, PER-ERIK	2
517.	18	HE, MENGTAO	2
518.	18	HELTOVICS, GABOR	2
519.	18	HEHN, ZYGMUNT	2
520.	18	HORIGUCHI, YASUNOBU	2
521.	18	HONG, KYUNG-WOO	2
522.	18	HOSHINO,EIICHI	2
523.	18	HONDA, KENJI	2
524.	18	HOLLWEDEL, URSULA	2
525.	18	HORIUCHI, TERUO	2
526.	18	HU, NAN-XING	2
527.	18	INOUE, AKIHIRO	2
528.	18	IACOBUCCI, PAUL ALBERT	2
529.	18	IDE, KAZUTOSHI	2
530.	18	ITASAKA KOICHI	2
531.	18	ITAKURA, KENSUKE	2
532.	18	ISHIMARU, TOMOYUSHI	2
533.	18	IP, JOHN	2
534.	18	INOUE, YOSHIHISA	2
535.	18	INGRAM, BARRY THOMAS	2
536.	18	INOE, SHINYA	2
537.	18	JANSSEN, ROGER JOSEPH ANNA	2
538.	18	JIGSTAM, MONICA	2

539.	18	JUNG,DIETER	2
540.	18	JUEN, DONNIE RAY	2
541.	18	JONG, KYONG-SU	2
542.	18	JORDAN, GLENN THOMAS IV	2
543.	18	JOHANSSON, INGEGARD	2
544.	18	JAIN, N.J	2
545.	18	JOETZJER, PASCALE	2
546.	18	KONISHI, Y	2
547.	18	KAISER, ROBERT	2
548.	18	KUBO, MAKOTO	2
549.	18	KU, JAE-KWON	2
550.	18	KUBOTO, KOZO	2
551.	18	KUNIEDA, HIRONOBU	2
552.	18	KUZINA, ZH. I	2
553.	18	KAWAKAMI, TAKANORI	2
554.	18	KABASHIMA, NOBUYOSHI	2
555.	18	KAMITANI, AKIRA	2
556.	18	KOBAYASHI, TETSUO	2
557.	18	KOBAYASHI , TOYOKO	2
558.	18	KEYS, GEORGE B	2
559.	18	KENNEY, MALCOLM E	2
560.	18	KANAMORI, TARO	2
561.	18	KATO, KENICHI	2
562.	18	KATO, DAISUKE	2
563.	18	KIMURA, YASUAKI	2
564.	18	KAMBE, HISASHI	2
565.	18	KAMIUSUKI, T	2
566.	18	KITANO, KEISUKE	2
567.	18	KAWAUCHI, AKIHIKO	2
568.	18	KOBAYASHI, HIDEKI	2
569.	18	KOBAYASHI, NAOKI	2
570.	18	KONDO, YUKISHIGE	2
571.	18	KASCHING, JUERGEN	2
572.	18	KONO, TAKESHI	2
573.	18	KOMATSU, TAKASHI	2
574.	18	KOTT, KEVIN LEE	2
575.	18	KITAZAWA, KOZO	2
576.	18	KITANO, KEISUKE	2
577.	18	KILGOUR, JOHN ALFRED	2
578.	18	KIKUCHI, TAKAJI	2
579.	18	KLOPOTEK,B.B.	2
580.	18	KUBOTA, HIROSHI	2
581.	18	KWETKAT, KLAUS	2
582.	18	LI, QIUXIAO	2
583.	18	LA, MESA	2

584.	18	LENOBE, BERTRAND	2
585.	18	LEE, DONG-HWAN	2
586.	18	LIN, CHENG WEN	2
587.	18	LAMNERS, RENE	2
588.	18	LI,YONGSHENG	2
589.	18	LANGE, ROBERT K	2
590.	18	LEE, SANG-WOON	2
591.	18	LEE, JAE-DUK	2
592.	18	LAUGHLIN, ROBERT G	2
593.	18	LANG, FRANK PETER	2
594.	18	LASSILA, KEVIN RODNEY	2
595.	18	LANNIBOIS-DREAN, HELENE	2
596.	18	LOEFFLER, MATTHIAS	2
597.	18	LUMLEY, AMY C	2
598.	18	LASSILA, KEVIN RODNEY	2
599.	18	LI, RUONIN	2
600.	18	LIPHARD, MARIA	2
601.	18	LIU, XIAN GQUN	2
602.	18	LEON, VINCENT G	2
603.	18	LOVEJOY, D.J	2
604.	18	LI, QUN	2
605.	18	LU, RUNHUA	2
606.	18	LEUPIN, JENNIFER ANN	2
607.	18	LEGEL, DIETER	2
608.	18	MACKAWA, KAZUO	2
609.	18	MATSUMOTO, SHOJI	2
610.	18	MAKI, MASATKA	2
611.	18	MIYANO, SHOICHI	2
612.	18	MORII, NORIYUKI	2
613.	18	MORT, PAUL	2
614.	18	MIRACLE, GREGORY SCOTT	2
615.	18	MIYAIRI, YOSHIO	2
616.	18	MORITA, HIDEO	2
617.	18	MATSUNAGA, SATOSHI	2
618.	18	MAO, HSIANG-KUEN	2
619.	18	MARUYAMA, SHINJI	2
620.	18	MATSUMOTO, HIROSHI	2
621.	18	MEINE, GEORG	2
622.	18	MOSS, THOMAS H	2
623.	18	MIMURA, YASUNARI	2
624.	18	MAYUZUMI, FUKUNOBU	2
625.	18	MATSUO, SHIGERU	2
626.	18	MEHROTRA, K.N	2
627.	18	MAURER, KARL-HEINZ	2
628.	18	MC GOWAN, STEVEN BALDWIN	2

629.	18	MOTTALEB, MOHAMMAD A	2
630.	18	MOTSON, H.R	2
631.	18	MORRISON, CHRISTOPHER ANDREW	2
632.	18	MORT, PAUL R, III	2
633.	18	MOON, JONG-YUL	2
634.	18	MIN, DOOSIK	2
635.	18	MIZUTARI, TAKEAKI	2
636.	18	NAGAO, MASAHIRO	2
637.	18	NAKAO, TOSHIHIRO	2
638.	18	NAKAMATSU, HIROSHI	2
639.	18	NAKAMURA, MASAKI	2
640.	18	NEMCOVA, I	2
641.	18	NEUSER, KRISTINA M	2
642.	18	NIHEI, SHUICHI	2
643.	18	NOMURA, HIROMI	2
644.	18	NAGO, YUMIKO	2
645.	18	NITTA, TOSHIKAZU	2
646.	18	NOMURA, MASAFUMI	2
647.	18	NORITAKE, FUMITOMO	2
648.	18	NISHIOKA, JUNKO	2
649.	18	NISHIMOTO, VICHIRO	2
650.	18	NIEENDICK, CLAUS	2
651.	18	NEZU, HIDEAKI	2
652.	18	NAKAHARA, YUTAKA	2
653.	18	OYAMA, MASAC	2
654.	18	OFUSU-A SANE, KOJI	2
655.	18	OHTANI, TAKASHI	2
656.	18	OLDENHOVE, LOUIS	2
657.	18	OLSEN, HANS SEJAR	2
658.	18	ONO, MASATO	2
659.	18	OSAWA, YASUO	2
660.	18	OBERLANDER, MICHAEL	2
661.	18	ONOTERA, AKIRA	2
662.	18	OTAGURO, TAKAHIRO	2
663.	18	OKUMA, MASAKAZU	2
664.	18	OHBORI, KOICHI	2
665.	18	OHORA, SHIGERU	2
666.	18	PARK, CHAN-YONG	2
667.	18	PENNINGER, JOSEF	2
668.	18	PAINTER, JEFFREY DONALD	2
669.	18	PAYNE, RICHARD	2
670.	18	PERRING, KEITH DOUGLAS	2
671.	18	PETIT, SERGE	2
672.	18	PERKINS, CHRISTOPHER MARK	2
673.	18	PICULELL, LENNART	2

674.	18	PESCADOR, JOSE	2
675.	18	PAPASSO, THOMAS MICHAEL	2
676.	18	PATIST, A	2
677.	18	PERELLA, JAMES E	2
678.	18	PIASEEKI, ANDRZEJ	2
679.	18	PARANT, BERNARD	2
680.	18	POLLACK, CHARLES	2
681.	18	REN, TONG-XIN	2
682.	18	REN, ZHI	2
683.	18	RAKUTANI, KENJI	2
684.	18	RHODE, OLIVER	2
685.	18	RYU, ILL-HWAN	2
686.	18	RHODE, OLIVE	2
687.	18	RANDALL, SHERRI LYNN	2
688.	18	RATHS, HANS-CHRISTIAN	2
689.	18	RATHJENS, ANDREAS	2
690.	18	REN, FUSHENG	2
691.	18	ROSIE, J.A	2
692.	18	RYAN, TRACY ANN	2
693.	18	SMITH, KIM R	2
694.	18	SMITH JAMES A	2
695.	18	SMIALOWICS, DENNIS THOMAS	2
696.	18	SHOJI, KENZO	2
697.	18	SONG, XIAOQING	2
698.	18	SMIRNOV, A.S	2
699.	18	STAVARACHE, ROMEO	2
700.	18	SPECKMANN, HORST-DIETER	2
701.	18	SULTANA SHIREEN B	2
702.	18	SHIN, SUN-HO	2
703.	18	STUTE, JUTTA	2
704.	18	SONG, ZHANQIAN	2
705.	18	SONODA, HIROTOSHI	2
706.	18	SHIMOO, KATSUYA	2
707.	18	SAIJO, HIROYUKI	2
708.	18	SAITO, TAKANORI	2
709.	18	SAITO, JUN	2
710.	18	SCHREIBER, MANFRED	2
711.	18	SCAMEHORN, JOHN F	2
712.	18	SCHAMBIL,F	2
713.	18	SCHRAMM, LAURIER L	2
714.	18	SMITH, GEORGE A	2
715.	18	STAEHLER, KATRIN	2
716.	18	SWOLE, EDDIE D	2
717.	18	SMERZNAK, MARK ALLEN	2
718.	18	SOMASUNDARAN, PONISSERIL	2

719.	18	SONG, XIAORUI	2
720.	18	STABLEY, GARTH E	2
721.	18	STANNM, CHARLES L	2
722.	18	SUN, HONGRI	2
723.	18	SUZUKI, MASAYASU	2
724.	18	SUZUKI, SHINICHI	2
725.	18	SAKUMA, ITARU	2
726.	18	SALO, KUMI	2
727.	18	SATOH, FUMITAKE	2
728.	18	SACARESCU, BOGDAN	2
729.	18	SAIZAWA, CHIHARU	2
730.	18	SMULDERS, EDWARD	2
731.	18	SMITH, JOHN WIILAIM	2
732.	18	SEIPEL, WERNER	2
733.	18	SHIRAI, MICHIO	2
734.	18	SIVIK, MARK ROBERT	2
735.	18	SCHRAMM, CHARLES JOHN, JR.	2
736.	18	SYMES, KENNETH CHARLES	2
737.	18	SRAMEK, JOHN A	2
738.	18	SUZUKI, TARO	2
739.	18	TAKEUCHI, YASUYO	2
740.	18	TAKANO, RUMI	2
741.	18	TAGAYA, HISAKO	2
742.	18	TAKAHASI, KAZUO	2
743.	18	TAKAHASHI, TOMONORI	2
744.	18	TAKATA, NAOKADO	2
745.	18	TAKADA, NAOKADO	2
746.	18	TAMURA, EIKO	2
747.	18	TAMURA, TAKAMITSU	2
748.	18	TOKINA NOBUO	2
749.	18	TOMA, YOJI	2
750.	18	TAKANO, IZUMI	2
751.	18	TOPCHIEVA, I.N	2
752.	18	TSUKUDA, KAZUNORI	2
753.	18	TRACY, DAVID JAMES	2
754.	18	THIELE, BJOERN	2
755.	18	TOKUDA, JUNKO	2
756.	18	TAKEZAWA,TSUNEO	2
757.	18	TAKEDA, TOKIJII	2
758.	18	TAKAHASHI, CHIE	2
759.	18	TAKEMATSU, NAOKI	2
760.	18	TONG, JIHONG	2
761.	18	THORNTHWAITE, DAVID WILLIAM	2
762.	18	TAYLOR, TIMOTHY J	2
763.	18	TANO, TETSUO	2

764.	18	TAKADA, RYOKO	2
765.	18	UNO, MINORU	2
766.	18	UNO, KOUHEI	2
767.	18	UCHIYAMA, TOSHIHIKO	2
768.	18	UMESAWA, SHOHEI	2
769.	18	VULFSON, EVGENY N	2
770.	18	VOGT, CARLA	2
771.	18	VARMA, R.P	2
772.	18	VESELOV, V.P	2
773.	18	VORONOV, S	2
774.	18	VENZMER, JOACHIM	2
775.	18	WINETZKY, DEBORAH	2
776.	18	WEERASORIYA, UPALI	2
777.	18	WEI, SHAO-HUA	2
778.	18	WAN, YINHUA	2
779.	18	WALA, JERZYKIEWIEZ. A.	2
780.	18	WEIBEL, A. THOMAS	2
781.	18	WEISS, ALBRECHT	2
782.	18	WANG, GENG	2
783.	18	WANG, JIPING	2
784.	18	WALDHOFF, HEINRICH	2
785.	18	WANG, YANSHENG	2
786.	18	WEAIRE, DENIS	2
787.	18	WU, SONGHU	2
788.	18	WEBERSKIRCH, R	2
789.	18	WILK, KAZIMIERA A	2
790.	18	WILSCH-IRRGANG, ANNELIESE	2
791.	18	WEERA WARDENA, A	2
792.	18	WELLER, JEANNE MARIE	2
793.	18	WUMANJIANG, ELI	2
794.	18	YAMAMOTO, KOICHI	2
795.	18	YOSHIMURA, TOMOKAZU	2
796.	18	YOSHIMOTO, MEGUMI	2
797.	18	YANG, JINZONG	2
798.	18	YOUNG, ROBERT	2
799.	18	YUN, LIU	2
800.	18	YUN, SUK-KEUN	2
801.	18	YU, HUA	2
802.	18	YU, JI-HO	2
803.	18	YAMADA, KENJI	2
804.	18	YAMADA, HIROYUKI	2
805.	18	YANG, GUOLIN	2
806.	18	YU, JIECHEN	2
807.	18	YAMABOSHI, HIROKI	2
808.	18	YAMAGUCHI,OSAMU	2

809.	18	ZHONG, WEIMING	2
810.	18	ZHU, YAN	2
811.	18	ZHAO, XIAODONG	2
812.	18	ZHANG, WEI-CAM	2
813.	18	ZHANG, YA-DONG	2
814.	18	ZHANG, GUO	2
815.	18	ZHUKOV, YU-N	2
816.	18	ZIMOCH, J	2
817.	18	ZHAO, YONG	2

CHAPTER - V

1. APPLICATION OF BIBLIOMETRIC LAWS:

After the analysis and interpretation of data, the next step is the application of bibliometric laws on the analyzed data to check their validity.

1.1 Bradford's Law of Scattering:

This law states that "If a group of journals are arranged in an order of decreasing productivity, i.e. the journals that yield the most relevant articles coming first and the most unproductive last, then the journals will be grouped into a number of zones, each producing a similar number of relevant articles". However, the number of journals in each zone will be increasing very rapidly and show a geometric progression.

The relation between the zones is to be given by the following equations:

$$1 : n : n^2$$

where, 1 is number of journals and 'n' is a multiplier.

From the collected data, I have chosen 405 periodicals carrying 1301 articles. Apart from that, most of the literature on surfactants and detergents was published in form of 3774 patents issued by 20 patent organizations. As the nature of patent publications is different than periodicals, I have excluded them for the purpose of testing Bradford's law.

In the first zone, 9 periodicals contained 424 items, in the second zone 57 periodicals contained 422 items and the remaining 339 periodicals contained 455 items in the third zone.

In other words, we can say that first 9 periodicals have covered 1/3 of total items (i.e. 424), next 57 periodicals have covered 1/3 items (i.e. 422) and 339 periodicals have also covered yet another 1/3 of the total items (i.e. 455). It means the number of items in the three zones is almost constant. This data has been taken from Table-1; Ranking of Periodicals. This analysis very closely shows the phenomenon of scattering of items in different zones of journals.

As the nuclear zone contains 9 journals, followed by 57 in second zone and 339 journals in third zone, the zone thus identified will form an approximately geometric series:

9 : 57: 339

9 = 9 x 1

Here, $57 = 9 \times 6$ (Approx.)

$339 = 9 \times 6 \times 6$ (Approx.)

therefore, $9 : 9 \times 6 : 9 \times 6 \times 6$

substituting 6 = n

we get $9 : 9n : 9n^2$

i.e. $1 : n : n^2$

(where 1 is number of journals in the nucleus and n is a multiplier)

Thus, Bradford's law is proved.

The number of journals in the nucleus can be obtained by plotting $f(r)$ and $\log n$ on semi logarithmic graph paper (a bibliograph), where $f(r)$ is cumulative frequency and $\log n$ is log of rank of journals as shown in the graph. This graph is drawn with the help of data analyzed and computed in Table-1.

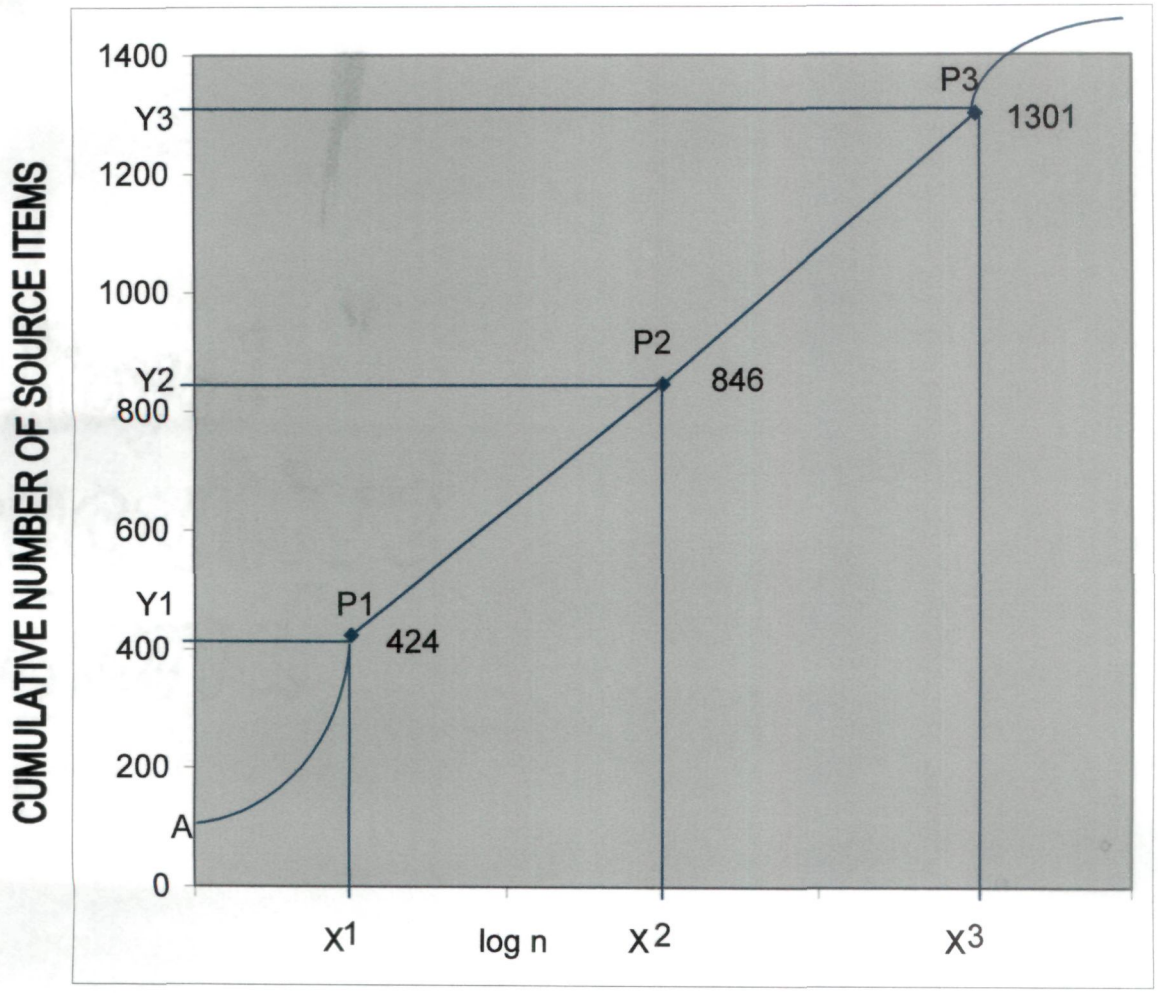
The log value of 9 journals in the first zone is 0.95424250. The log value of 57 journals in the second zone is 1.755874856. The log value of 339 journals in the third zone is 2.530199698.

Table – 8

BRADFORD'S TABLE

S.No.	No. of Journals	Cumm. Journals	No. of Items	Cumm. of Items
1	1	1	87	87
2	1	2	66	153
3	1	3	57	210
4	1	4	42	252
5	1	5	39	291
6	1	6	36	327
7	1	7	35	362
8	1	8	31	393
9	1	9	31	424
			424	
10	2	11	46	470
11	2	13	28	498
12	3	16	37	535
13	5	21	50	585
14	2	23	20	605
15	6	29	48	653
16	3	32	27	680
17	10	42	60	740
18	10	52	50	790
19	14	66	56	846
			422	
20	18	84	54	900
21	7	91	21	921
22	33	124	60	981
23	19	143	38	1019
24	11	154	22	1041
25	9	163	18	1059
26	61	224	61	1120
27	74	98	74	1194
28	53	351	53	1247
29	54	405	54	1301
			455	

DIGRAM 6. BRADFORD'S BIBLIOGRAPH



Taking $\log n$ on x-axis and taking number of items in each zone on y-axis, a graph was plotted. The bibliograph thus obtained was found to be, by and large, similar to Bradford's bibliograph, as the graph begins a rising curve. AP1 and continues as a straight line. The rising part of the graph represents the nucleus of highly productive journals. The points P1, P2 and P3 on bibliograph are the boundaries of the three equiproductive zones in which almost the same number of articles as the nucleus (represented by 1 = y1 y2 = y2 y3) derived from an increasingly large number of journals (represented by 0x1, x1x2 and x2x3). The Bradford's law is proved thus.

1.2 Lotka's Inverse Square law:

This law states that the number of scientists who contributes 'n' papers will be $1/n^2$ of those who contribute only one paper.

During the present analysis it was observed that 18,035 have contributed 5075 items. Out of 18,035 authors only 817 authors have contributed more than one paper and rest 17,218 authors contributed one paper each i.e. single contribution.

However, according to Lotka's Law, single contributors should account for 60% of the total.

Lotka's Law was applied to know the number of scientists contributing 2 papers, 3 papers and 4 papers respectively, as given below:

1.2.1 Scientists Contributing two Papers:

As we know the number of authors contributing one paper is 17,218. Therefore, number of Scientists contributing 2 papers may be calculated by the formula:

No. of Scientists publishing 1 paper $1/n^2$

$= 17218 \times 1/2^2$

$= 17218/4$

$= 4304.55$

Thus, number of scientists publishing 2 papers is 4304.5. However an analysis of the data shows that only 495 have contributed 2 papers, which is far less than the 4304.5 figure, obtained by applying Lotka's Law.

1.2.2 Scientists Contributing three papers:

Apply the formula:

$=1/n^2$

$=17218 \times 1/3^2$

$= 17218/9 = 1913.11$

During the analysis it was found that only 129 authors contributed 3 papers each, which is far less than 1913.11

1.2.3. Scientist contributing four papers:

Applying the formula

$=1/n^2$

$=17218 \times 1/4^2$

$= 17218/16 = 1076.12$

Number of authors contributing 4 papers = 1076.12

The analysis of the actual data shows that only 81 authors contributed 4 papers which is again far less than calculated figure.

It may therefore be concluded that the trends of research nowadays have changed as compared to the period when Lotka's Law was formulated. That is why on the basis of analysis of the present data it is different to testify the Lotka's Law.

1.3 Zipf's Law of word Occurrence:

This law states " In a long textual matter if words are arranged in their decreasing order of frequency, then the rank of any given word of the text will be inversely proportional to the frequency of occurrence of the words"

$R \propto 1/f$

Where, r is rank

F is frequency of word occurrence

Fr=Constant

For the application of this law I have collected those words, whose frequency of occurrence is more. I have collected the words from the title of the articles and presented them in Table-9 according to their frequency of occurrence in decreasing order.

Table-9 shows distribution of words is inversely proportional to the frequency of occurrence of the word. The law represents only approximation of occurrence, which is hyperbolic.

Zipf's law:

F(r) = c/n , where c is constant

Log F (r) + log n = C

On application of this law we found that the log of frequency of occurrence of words when added to log of their rank, the results are almost same for each word as:

I. Word- Composition Frequency – 1052 times Rank – 1

log of frequency + log of Rank

log 1052 + log 1

=3.0220+0

=3.0220

II. Word – Surfactants Frequency – 574 times Rank – 2

log 574+ log 2

=2.7589+0.3010

=3.0599

III. Word – Detergents Frequency – 519 times Rank – 3

log 519 + log 3

=2.7151+0.4771

=3.1922

Zipf's law is proved thus.

TABLE – 9

RANKING OF WORDS

S.No.	Rank	Words	Frequency	Log C = Constant
1	1	Compositions	1052	3.0220
2	2	Surfactants	574	3.0599
3	3	Detergents	519	3.1922
4	4	Cleaning	476	3.2796
5	5	Comprising	418	3.3201
6	6	Containing	383	3.3613
7	6	Determination	383	3.3613
8	6	Properties	335	3.3701
9	7	Synthesis	322	3.4109
10	8	Preparation	322	3.4109
11	9	Method	301	3.4328
12	10	Application	280	3.4471
13	11	Washing	245	3.4305
14	12	Fabric	232	3.4445
15	13	Manufacture	226	3.4680
16	14	Removal	213	3.4745
17	14	Solution	213	3.4744
18	15	Use	186	3.4456
19	16	Bleaching	69	3.0429
20	17	Emulsion	61	3.0157
21	18	Laundry	58	3.0187

CHAPTER - VI

CONCLUSION AND IMPLICATIONS

Bibliometric analysis is now becoming an important research tool for the understanding of Science, Scientists, Scientific contributions and publications. Bibliometric techniques are being applied for eliminating low quality literature and to select a small portion of significant, reliable and relevant high quality publications. These are also applied for the management of science, analyzing the utility of journals and fields and measuring the performance of scientist.

The present study was conducted to identify the distinguished characteristics of the literature on 'Surfactants and Detergents' with the help of well-established method of bibliometrics. The source document 'Chemical Abstract' has been selected for collecting data. The subject area selected is 'Surfactants and Detergents' which deals with the preparation, utilization and improvement of surfactants and Detergents. The main objective of this bibliometric study is as following:

- To compile a ranked list of journals
- To find out the individual contribution of significant authors and observe authorship pattern
- To distribute cited serials according to their country of origin and languages
- To find out the form of the documents used in the subject field.
- To observe chronological distribution and frequency of cited journals.

Table-1 gives a ranking list of 405 Journals. The most productive periodicals in the field of Surfactants and Detergents are:

1. Riyong Huaxue Gongye	87(1.71%)
2. Journal of Surfactants and Detergents	66(1.30%)
3. Surfactant Science Series	57(1.12%)
4. Communication Journal of Commercial Detergents	42(0.82%)
5. Jinxi Huagong	39(0.76%)

This study will help the librarian in deciding as to which periodicals in the field of Surfactants and Detergents may be subscribed in the library.

While studying the use pattern of research literature in a particular discipline like Surfactants and Detergents, it is important to determine geographical scattering of cited journals.

It is clear from the Table-2 that the literary output of Japan is more as compared to other countries, as it accounts for about 25.57% of the total data. The 2^{nd}, 3^{rd}, 4^{th}, & 5^{th} position were held by Switzerland (19.66%), USA (9.77%), China (8.19%) and Germany (7.4%) respectively.

In this table 49 Countries have been listed, this also shows the wide range of the source document. This study will help the librarian in deciding from which country he has to produce the documents.

Chronological study in Table-3 shows that maximum number of items have originated during the year 1999 (46.22%). The other productive years are 1998 and 2000 accounting for 12.78% and 33.91% literature respectively. This study shows how currently information is being published by Chemical Abstracts.

Language wise analysis shows the most dominant language of scientific communication in he field of surfactants and Detergents. Table-4 shows that 42.64% literature in the field of Surfactants and Detergents is published in English language. About 57.36% literature of Surfactants and Detergents is being published in other languages such as Japanese (27.33%) Chinese (11.38%), German (9.95%), Korean (3.40%), Russian (1.69%), French (1.16%) and so on. This analysis suggests that scholars should know at least one foreign language other than English and librarian should have adequate translation facilities.

Subject dispersion analysis in Table-5 shows that 12.80% literature belongs to Physical Chemistry and rest of the literature is scattered in other disciplines like Analytical Chemistry (3.44%), Organic Chemistry (2.36%), Chemistry (2%), Chemical Engineering (1.37%) and so on.

This study may help the librarian in the provision of abstracting, indexing, CAS and SDI services.

The foremost conclusion drawn from Table-6 is that world output is dominated by the patents, as 74.36% of the total data was found to be in form of patents.

Ranking of authors has been done to know the eminent personalities in the field of Surfactants and Detergents. From this analysis it was found that 730 items (14.38%) were contributed by single author, 1465 items (28.86%) by two authors and 2880 (56.74%) by more than two authors. From Table-7 the eminent personalities in the subject under study were found to be:

1. Lietzmann, Andreas (30 items)
2. Takano, katsuyuki (22 items)
3. Ogura, Nobuyuki (22 items)
4. Horie, Hiromichi (21 items)

The ranking of authors shows the recent trends of research in the subject Surfactants and Detergents.

At last the bibliometric laws such as Bradford's Law, Lotka's law and Zipf's law have been applied. Among them Bradford's and Zipf's laws have been testified as they are still valid today. Bibliometric studies are of much significance for the designers of catalog codes, for the compilers of bibliographies and for the organizers of scientific informations. Further research is required to establish its impact on the organization of research and communication pattern of scientists in the field of Surfactants and Detergents.

Tenability of the Hypothesis:

The hypothesis, which I have set for the present study, has been examined in the light of above findings.

According to the result of the study all the hypothesis that I have set are fully substantiated.

BIBLIOGRAPHY

1. PRITCHARD (A). Statistical bibliography on bibliometrics. *Journal of Documentation*. 25; 1969; 348 – 49.

2. GUHA (B). Documentation and information. 1978. World Press, Calcutta.

3. FAIRTHORNE (RA). Empirical hyperbolic distribution for bibliometrics description and prediction. *Journal of documentation*.25; 1969; 319 – 43

4. EGGHE (L). Methodological aspects of bibliometrics. *Library science with a slant to documentation and information studies*. 25, 3; 1988; 179 – 91.

5. DEVARAJAN (G). Bibliometric studies. 1997. Ess Ess Publication, New Delhi.

6. COLE (EJ) and EALES (NB). History of comparative anatomy. Part 1: A statistical analysis of literature. *Science Progress*. 11; 1917; 578 – 89.

7. SHARMA (BK). Industrial Chemistry. 1996. Krishna Prakashan Media, Meerut.

8. SRIVASTVA (SB) and GUPTA (RK). Household detergents and industrial surfactants. Small Business Publications, Delhi.

9. KALI CHARAN. Technology of laundry and toilet soaps. Small Business Publications, Delhi.

Websites:

1. http //www sdahq org/laundry/fact/fact_sheet2 html

2. http //www sdahq org/sdalatest/html/soapchemistry1 htm